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E.G.

A Preliminary Classification of Riparian ~~Rolaroam~~ Communities Along East Fork Smith's Fork River

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

847

R-4

REPLY TO: 2250 Cooperation

MAR 10 1980

SUBJECT: Cooperative Project on Riparian Community Classification

TO: Directors, A&FM, E, L, M, RM, RN, S&WM, TM, and WL and Forest Supervisors, Ashley, Bridger-Teton, Caribou, Uinta, and Wasatch N.F.'s

W.S.C.

Enclosed is a copy of the Final Report submitted by Weber State College entitled: "A preliminary classification of riparian communities along East Fork Smiths Fork River."

We plan to verify and expand this classification with additional field studies during fiscal year 1980. Dave Winn will supervise the field crew conducting the vegetation and wildlife studies. The Wasatch National Forest has been requested to support this effort by providing technical expertise to help characterize the soil-vegetation relationships for the classified types.

JEFF M. SIRMON
Deputy Regional Forester
Resources

Enclosure

cc:
INT (Roger Bay)
(Walt Mueggler)
(Warren Clary)
(Bob Steele)
(Bob Pfister)

A PRELIMINARY CLASSIFICATION OF RIPARIAN COMMUNITIES ALONG EAST FORK SMITHS FORK RIVER

FINAL REPORT - MARCH 1980

by

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INTRODUCTION

Numerous attempts have been made recently to develop land classification systems which would not only deal with terrestrial ecosystems but also the aquatic and/or riparian[1] ones. Such classification systems, when developed become important aids to research and management planning. An attempt was made to develop a single classification system that would combine terrestrial and aquatic habitats (Corliss et al. 1973). This resulted in the ECOCLASS classification system which has as its major failure the fact "that the aquatic environment could not be united with the terrestrial environment at levels needed for planning" (Platts 1979). Platts (1979), reviews prior attempts to work stream habitats into land planning and discusses major short-comings. In his study, Platts develops a system which integrates all streams and their fisheries into the Land Systems Inventory of Wertz and Arnold (1972).

Recognizing that valley bottomlands may additionally include lentic habitats, attempts were made to deal specifically with classification of such ecological units.

To this end, the work of Pfankuch (1975), Bailey (1976), Dunham and Collotzi (1975), and Thomas et al. (1979), are especially significant. A procedure for mapping and interpreting valley bottomland units with management implications

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[1]Riparian ecosystems are defined as wetland ecosystems which have a high water table because of proximity to an aquatic ecosystem or subsurface water. Riparian ecosystems usually occur as an ecotone between aquatic and upland ecosystems, but have distinct vegetation and soil characteristics.

is given in a technical guide of the U.S. Forest Service (1979). This guide suggests that valley bottomlands may be stratified into terrestrial, riparian and aquatic zones; the latter being unique to the valley bottomland system.

The study reported here deals almost entirely with the riparian zone within the valley bottomland system. The riparian zone is of ever increasing importance as an area requiring much attention from the standpoint of multiple-use management of our national forests and rangelands. The importance of the riparian zone cannot be over emphasized, especially in the arid west where many conflicting uses occur simultaneously. A good detailed account of the importance of the riparian zone in both ecological and management contexts is offered by Thomas et al. (1979), however, some highlights are worthy of mention.

Riparian regions are considered the most critical wildlife habitats in managed rangelands because of the disproportionately higher use by and production of wildlife than in any other habitat. For example, many studies beginning with MacArthur and MacArthur (1961) and summarized by Balda (1975), have shown the relationship of foliage complexity to bird species diversity. Riparian vegetation is often more complex than surrounding plant communities and thus supports a higher diversity of birds. In addition to resident populations of animals the riparian region also becomes a temporary home for terrestrial, aquatic and semi-aquatic species. The riparian zones are highly productive forage

sites and being near water become heavily used by domestic livestock. This latter use can very easily become an abuse or overuse unless proper management policies are established and followed (Ames 1977, Davis 1977). The effects of grazing may also affect the associated aquatic systems. Kennedy (1977) showed that fish weigh less and are less abundant in grazed portions of streams.

Due to their relatively gentle topography the riparian zones become attractive locations for the construction of roads. They additionally provide apparently accessible supplies of rock and gravel for such construction. For a variety of reasons, mining activities have had marked impacts on riparian regions. Since riparian zones also have a high, innate scenic value they are receiving increasing pressure from recreational activities. We may very soon find out the exact limits of recreational pressure upon riparian zones.

Riparian zones, because of their relatively small size, their unique microclimatic features and their extremely high diversity of community types represented by a mosaic of communities with a disproportionately high edge-effect are considered vulnerable to severe alteration (Thomas et al. 1979). The riparian communities, in turn, have a very significant impact on the aquatic system which it surrounds. For these reasons, riparian zones represent a unique challenge for land managers. Also, for these reasons, more detailed ecological information must be gathered from riparian zones to aid in this management challenge.

OBJECTIVES

This study develops a riparian classification for the East Fork Smiths Fork drainage on the Wasatch National Forest and reflects the relationship of riparian communities to the aquatic and valley bottomland systems and addresses specifically the vegetation, soils and wildlife. In specific point form the objectives of this study were to:

1. Develop a riparian community classification.
2. Apply the classification to an adjacent drainage to demonstrate its usefulness as a workable mapping system.
3. Determine the relationship of the riparian communities that are defined to the following:
   a. Valley bottomland units.
   b. The relationship of the riparian communities to one another.
   c. The relationship of the riparian communities to the hydrologic-aquatic system.
   d. Determine the wildlife species diversity and population structure in each of the defined riparian communities.
   e. Determine the soil-vegetation relationships for each riparian community.

GENERAL PROCEDURE

1. Define the valley bottomland units and potential riparian communities for the East Fork Smiths Fork watershed system on topographic maps.
2. By field reconnaissance, define and delineate the riparian communities.
3. Plan a logical sampling system whereby the defined riparian communities can be sampled most efficiently in terms of the time and manpower available so as to obtain the samples during those periods in the summer season when each community is at an optimum stage of vegetative growth.
4. At each study site (transect site), sample the parameters as outlined in the methods section below.
5. Following the collection of field data, develop a preliminary classification so as to reflect the results of the sampling.
6. Analyze all data, collection methods, the preliminary classification developed and report the findings and make recommendations for the resolution of problems encountered and for modifications in future studies.

METHODS

I. General and Physical Features

The length of East Fork Smiths Fork River which was studied ran from section 15 T. 1 N., R. 5 W. Uinta Meridian Summit Co., Utah through to section 32 T. 13 N., R 115 W. Black Hills Meridian, Uinta County, Wyoming over a distance of 22 miles.

A total of sixty-five study sites, selected on the basis of attempts to represent a variety of riparian communities located in the different stream gradient reaches were chosen. These study sites (transect sites) along with stream gradients and selected elevations are found on the map of the area of study in Figure 1. Each of the study sites were marked on four corners with wooden survey markers then permanently marked on the downstream toeslope corner with 3/8" steel rods.

This drainage, along with the adjacent drainages on the north slope of the Uinta Mountains, has been worked extensively by several glacial episodes. The resulting terminal and lateral moraines have often blocked the surface streamflow causing numerous meadows with shallow stream gradient (0-2%), connected by reaches of steeper gradient (2-3%).

The following are specific field parameters measured at each study site to relate the riparian community to the valley bottomland units and the hydrologic-aquatic system.

1. Width of valley bottomland unit at transect.
2. Distance of riparian habitat from the edge of the valley bottomland unit.
3. Distance of riparian habitat in which measurements were taken from the stream channel.
4. Stream order and watershed area above transect. Stream order was defined on the basis of a 7½ minute topographic map using perennial streams only. Perennial unbranched tributaries are of first order. Tributaries on streams of the second order receive two or more first-order branches or tributaries only. A third-order stream received two or more second-order tributaries but also received first-order tributaries. Higher orders were similarly defined.
5. Width and depth of stream at time of measurement and at bankful capacity.
6. Sinuosity ratio (length of channel relative to linear straight line length of the valley bottomland unit).
7. Channel stability evaluation using Region 1 technique (Pfankuch, 1975).
8. Stream bottom material. This was based on point sampling of the stream adjacent to the riparian community study site. The method adopted here was that of Region 1 technique (Pfankuch, 1975) rather than the method proposed in the original agreement since the former method permitted greater refinement and accuracy.

Size Composition of Bottom Materials (Total to 100%)

1. Exposed bedrock	____	5. Small rubble, 3"-6"	_____
2. Large Boulders, 3' + Dia.	____	6. Coarse Gravel, 1"-3"	_____
3. Small Boulders, 1-3' Dia.	____	7. Fine Gravel, 0.1"-1"	_____
4. Large Rubble, 6"-12"	____	8. Sand, silt, clay, muck	_____

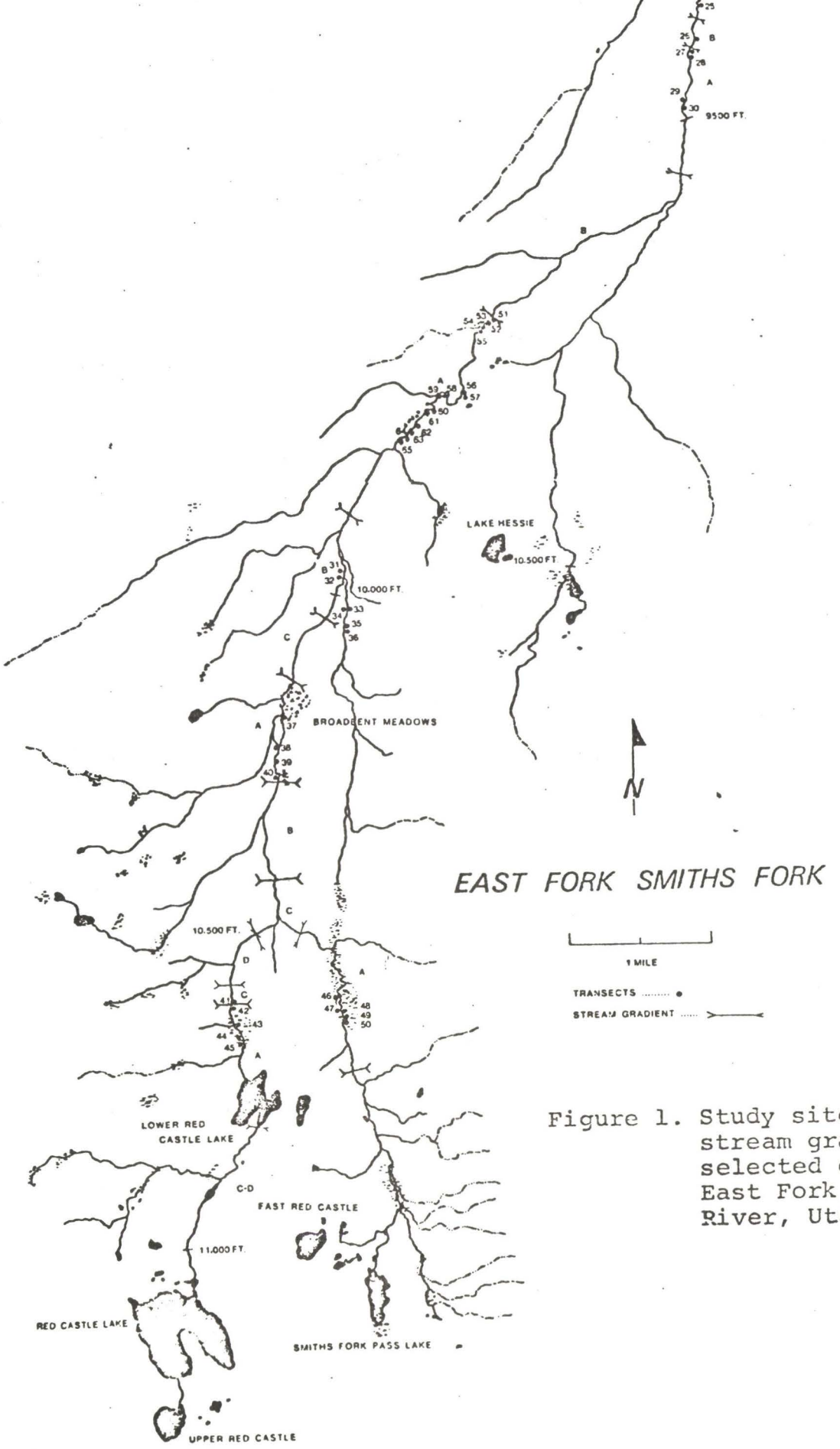
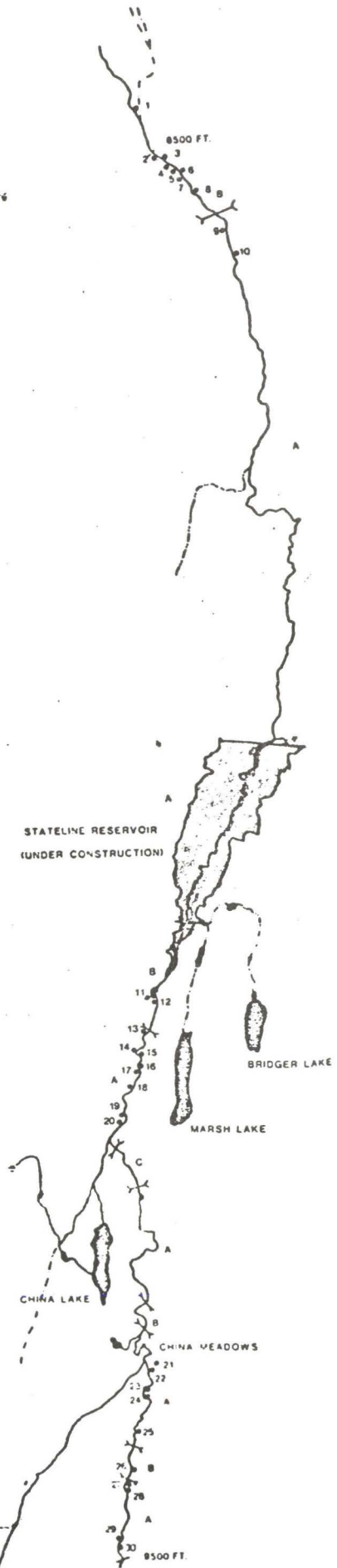


Figure 1. Study sites (transects), stream gradients and selected elevations alon East Fork Smiths Fork River, Utah.


8500 FT.
STATELINE RESERVOIR
(UNDER CONSTRUCTION)
BRIDGER LAKE
MARSH LAKE
CHINA LAKE
CHINA MEADOWS
8500 FT.

9. Cobble imbeddedness - The degree to which dormant stream substrate material is covered by sediment.

Rank	Imbeddedness Classification
1	Completely or nearly completely imbedded
2	3/4 imbedded (moderate)
3	1/2 imbedded (intermediate)
4	1/4 imbedded (light)
5	Unimbedded

II. Methods Used for Soils Determinations

In each study site a soil pit was dug with a shovel to a depth determined by the underlying strata of boulders and rubble which were usually present and firmly imbedded. Soil pit sites were located 10 m from the downstream-toeslope corner marker towards the upstream-streamside marker. In this way the soil pit fell nearly in the center of the rectangular study site. The profile characteristics were then studied as follows:

a. Soil texture of the A horizon was determined by the feel method (Brady 1974) using the soil classes: loam, clay loam, silt loam, sandy loam and sandy clay.

b. Horizon characteristics: general colors, depth, structure, gravel, hardpans, organic matter etc., were noted and recorded in a field notebook. A soil sample was taken from the A horizon of each profile. Munsell color notation and soil pH

were determined in the laboratory for these samples. Using the colors and the field descriptions the soils were classified from order to family levels by reference to USDA Soil Taxonomy (1975).

c. Infiltration rates were estimated from plant cover on the soil and textural characteristics by referring to printed averages (Kohnke 1968).

d. Permeability rates and water holding capacity were estimated using the textural and structural characteristics of the soil and by reference to averages reported by Brady (1974).

e. Hydrological soil group, run off and drainage class were estimated from texture and structure with reference to standards reported by Brady (1974) and U.S. Forest Service Handbook (1965).

f. Inherent erodibility was estimated by determining the stability of the soil granules using a spray of water from a plastic squeeze bottle. Results were interpreted by reference to categories previously reported in U.S. Forest Service Handbook (1965).

g. Current erosion rate was estimated using plant cover, slope, soil texture, and evidence of surface erosion.

h. Soil pH was determined with a portable pH meter.

III. Methods For Vegetation Studies

At each of sixty-five study sites adjacent to East Fork Smiths Fork a rectangular area 15 m x 30 m (450 m^2) was laid out in a stand of water-influenced vegetation either parallel or perpendicular to the stream, depending on the size of the valley bottomland, and marked at the four corners with semi-permanent stakes and flagging. Within the rectangular area five parallel transects spaced at approximately 2.5 m apart were laid out each with six, m^2 quadrats spaced approximately 6 m apart along the transect, for a total of 30 quadrats.

In each m^2 quadrat the herbaceous vegetation was identified. During a training period early in the season the herbage in each quadrat was clipped and weighed fresh. Each sample of herbage was later dried and weighed again. The field specialist trained herself to estimate the fresh herbage weight and then clipped and weighed the herbage to reduce the estimation error. At sites studied later in the field season the herbage of only a few of the 30 quadrats was weighed fresh, later dried, and then dry weights obtained. The fresh weight of the herbage on the remainder of the quadrats was estimated and then the dry weight of herbage calculated from averages of samples taken.

The percent crown canopy coverage of shrubs was estimated for each m^2 quadrat, if present, by visually projecting the canopy downward onto the plot. The height of the canopy of shrubs was recorded for each quadrat adjacent to or including shrubs. (Pfister et al. 1977).

The percent crown canopy coverage for trees was determined with a device constructed of a mirror with dots spaced equally in a grid pattern (David S. Winn, personal communication). The number of dots within the canopy image gave the crown canopy coverage. The crown canopy coverage was not delineated by species, which limited these data.

The percent of dead wood in each quadrat was visually estimated as a percent of area covered by such material in each quadrat.

Relatively few of the 65 study sites were dominated by trees. For each of these study sites the data on overstory of the first ten individual trees of each species present (over 4 cm dbh) along the transects were recorded as follows: (1) species (2) total tree height (3) height to the lowest live limb (4) distance from the center of the trunk to the first live foliage on the longest branch (5) outer crown diameter in m (6) trunk diameter at breast height (7) age of the tree as determined from an increment core (8) the tree condition and (9) estimates of limb length each two meter band (so that volume of foliage in each two meter band of the tree canopy could be calculated later). This foliage volume method follows Franzreb and Ohmart (1978).

Similarity indices were calculated according to the technique described by Bray and Curtis (1957). These indices were clustered using the Sorensen's K (Sorensen 1948)

cluster method producing a similarity matrix and dendogram. These analyses were made using U.S.F.S. computer programs. The results of these analyses formed the basis of the vegetation classification system developed here.

IV. Methods for Wildlife Studies

Birds were censused in each of the 65 study sites using modified Emlen (1971) transects. Counts were done between 14 June, 1979 and 28 August, 1979 proceeding from lower to higher elevations. All counts were completed before 0900. Two counts were made on each of sites 1-20 and three each on sites 21-65. Additional species were noted during reconnaissance of other riparian areas.

Small mammals were trapped in 50 study sites using grids of Sherman live traps baited with rolled oats and peanut butter. Forty traps were used in most sites and 10 or 20 traps in those sites where accessibility was very difficult. Visual observations of small mammals and their sign were also recorded.

No quantitative techniques were used for big game mammals, domestic livestock or reptiles and amphibians. Observations and sign of these species were recorded as they were encountered during other activities and in reconnaissance of riparian areas.

Indices of similarity between study sites for both birds and mammals were calculated according to the technique of Bray and Curtis (1957). These indices were clustered to produce association tables and a similarity

matrix based on Sorensen's K (Sorensen 1948). These analyses were done with U.S. Forest Service computer programs.

All diversity indices were calculated using the following formula (Shannon and Weaver 1963):

$$H' = \sum_{i=1}^{s} p_i \log_2 p_i$$

to account for both the presence of each species and relative abundance of species. Higher H' values indicate more species present and/or even distribution of individuals among the species. Species evenness was calculated from Pielou's (1969) formula:

$$J' = \frac{H'}{H' \text{ max}}$$

Values near unity indicate that all species have nearly equal densities. Values near 0 indicate dominance by a single species.

Foliage in 30, 1 m^2 plots in each study site was classified into five height categories (0-0.6, 0.7-1.0, 1.1-1.5, 1.6-3.0, >3.0 m) and used to calculate foliage height diversity (FHD) using the Shannon-Weaver formula above. These FHDs were compared to bird species diversities (BSD) by correlation analysis as were percent canopy cover of both trees and shrubs in order to compare bird populations with habitat structure.

RESULTS AND DISCUSSION

I. General

Data on stream, riparian and valley bottomland parameters for East Fork Smiths Fork are given in Appendix A. Of note is the time of the study during which these data were collected, this period being the late summer of 20 August, to 3 October, 1979. During this time the river flow was at or near its minimum allowing one to observe the dominant stream bottom material and the degree of cobble imbeddedness. Even at this late date the stream at study sites 57 and 58 was too turbid to observe the bottom material and its imbeddedness (which was estimated). At this late period, however, estimating stream depth at bankful capacity becomes rather more difficult.

II. Soils

The results of the soils investigation, as outlined in the methods section, appear in summary form as soil families in Appendix B. Results of laboratory analyses of soil samples taken from the A horizon of soil pits dug are given in Appendix C. It is important to point out that soil investigations in high elevation riparian habitats can not be carried out until late summer during the period of a lowered water table. This may play a role in future investigations planned for riparian habitats in mountain regions.

III. Vegetation

The hierarchal structure of the palustrine ecological system as defined by the Fish and Wildlife Service in "Classification of Wetlands and Deep-Water Habitats of the United States" (1977), was used as a model to develop the preliminary classification of riparian communities along East Fork Smiths Fork. This classification delineates the vegetation on the basis of class, subclass, dominance type and phase levels. The class describes the general appearance of the habitat in terms of plant life features (physiognomic) which can be recognized without the aid of detailed environmental measurements. The use of life forms at the class level has two major advantages: (1) it does not require a high level of biological expertise to distinguish between various life forms, and (2) various life forms are easily recognized on remote-sensing generated photos.

The subclass level characterizes the groups of predominant plants which make up the physiognomy. Dominance types are determined on the basis of the dominant plant species which has control over the community and is usually the predominant species. In many instances this involves two or more species which act as codominants. The smallest group to characterize the community is the phase and separates dominant types on the basis of species of a similar nature, for example, Salix geyeriana rather than Salix caudata in a tall willow dominance type.

The class: shrub wetland includes areas dominated by woody vegetation less than 6 m in height. Along East Fork Smiths Fork this class is dominated by willow communities where they appear relatively stable. They provide a source of food for a large population of moose and are thus often found in a heavily browsed condition. This has a bearing on the ease with which the species of Salix can be identified.

The class: emergent wetland is characterized by erect, rooted, herbaceous hydrophytes, which are present for most of the growing season in most years. Emergent wetlands are known by the names marsh, meadow, fen and slough. Persistent emergent wetlands are dominated by species that normally remain standing at least until the beginning of the next growing season. Most of the sedges, rushes, and grasses in the emergent wetlands of East Fork Smiths Fork fit this classification.

The vegetation classification for riparian communities along the East Fork Smiths Fork River follows. Note that this is presented by study site, the number of which is circled and follows either the appropriate dominance type or phase level.

CLASS I FORESTED WETLAND

Subclass 1. BROAD-LEAVED DECIDUOUS

Dominance Type a. Aspen-Cottonwood (1)

Dominance Type b. Aspen (7)

Subclass 2. MIXED (NARROW-LEAVED EVERGREEN & BROAD-LEAVED DECIDUOUS)

Dominance Type a. Lodgepole-Aspen

Phase 1. Rowo-Pofr (2) (3) (4) (5) (6)

Phase 2. Tall Willow-Juco (8)

Phase 3. Tall Willow (10)

Subclass 3. NARROW-LEAVED EVERGREEN

Dominance Type a. Lodgepole-Tall Willow (9) (28)

Dominance Type b. Lodgepole-Juniper-Sedge (26)

CLASS II SHRUB WETLAND

Subclass 1. TALL WILLOW DOMINANT

Dominance Type a. Tall Willow-Sedge

Phase 1. Sage-Caaq (42) (48)

Phase 2. Sage-Cami-Cake (23) (24)

Phase 3. Sage-Caau-Cars (49)

Phase 4. Sage-Saca-Caaq-Cami (61)

Phase 5. Saca-Cars-Cavs (34)

Phase 6. Sasu-Cami (40)

Dominance Type b. Tall Willow-Dwarf Willow-Sedge

Phase 1. Sage-Cars (22) (25)

Phase 2. Saca (37) (39)

Phase 3. Saca-Sage-Cars (62) (63) (65)

Phase 4. Saca-Sage-Caaq-Cars (64)

Subclass 2. DWARF WILLOW DOMINANT

Dominance Type a. Dwarf Willow-Sedge

Phase 1. Cars (15) (17) (18) (27)

Phase 2. Cala (31)

Phase 3. Caaq-Cami (46) (47)

Phase 4. Caaq-Cars (50)

Phase 5. Cars-Cavs (33)

Dominance Type b. Dwarf Willow-Tall Willow-Sedge

Phase 1. Sage-Cami (14) (16) (19)

Phase 2. Sage-Mixed Sedges* (20)

Phase 3. Sasu-Cars-Cavs (30)

Phase 4. Saca-Cars-Cavs (29) (36)

Phase 5. Saca-Mixed Sedges* (35)

Phase 6. Saca-Cala (32)

Phase 7. Saca-Cami (54) (55)

Dominance Type c. Dwarf Willow-Sedge-Rush (43) (44)

CLASS III EMERGENT WETLAND

Subclass 1. PERSISTENT

Dominance Type a. Sedge-Rush-Grass

Phase 1. Cars-Juba (11)

Phase 2. Cami-Juha (38)

Phase 3. Cars-Judr (21)

Phase 4. Cami-Jual (51) (53) (59) (60)

Phase 5. Cavs-Cars-Judr (52)

Dominance Type b. Sedge-Grass

Phase 1. Cavs-Cars-Cala (57)

Phase 2. Cars (12)

Phase 3. Cars-Cala (13)

Phase 4. Cave (56) (58)

* No clear sedge dominant(s)

Keys to the above vegetation classification are found in Figure 2. The first key separates the three classes viz. Forested Wetland, Shrub Wetland and Emergent Wetland. Each class is then further delineated into subclass, dominance type (d.t.) and, where necessary, phase. Although the key to the Emergent Wetland class contains a non-persistent subclass, this subclass was not represented in the riparian vegetation of East Fork Smiths Fork.

A complete species presence list for the entire riparian study area is given in Appendix D. Along with the scientific and common name of each species the four-letter abbreviated notation, used by the U.S. For. Ser., is given. Such abbreviations provide for more rapid shorthand field notation which saves considerable time but requires an initial outlay of time on the part of the field researcher to become familiar with their use.

A total of three classes, six subclasses and twelve dominance types were delineated on the basis of the following: (a) percent

Figure 2. Key to the vegetation along East Fork Smiths Fork River, Utah.

KEY TO VEGETATION CLASSES

1. Habitats dominated by trees..... FORESTED WETLAND CLASS (A)

1. Habitats not as above..... 2

2. Habitats dominated by shrubs.... SHRUB WETLAND CLASS (B)

2. Habitats dominated by sedges and grasses..... EMERGENT WETLAND CLASS (C)

A. KEY TO FORESTED WETLAND CLASS

1. Broad-leaved deciduous trees dominant..... BROAD-LEAVED SUBCLASS (2)

2. *Populus tremuloides* and *Populus angustifolia* codominant..... ASPEN-COTTONWOOD d.t.

2. *Populus tremuloides* dominant.... ASPEN d.t.

1. Broad-leaved deciduous trees not dominant..... 3

3. Mixed-narrow-leaved evergreen (*Pinus contorta* var. *latifolia*) and broad-leaved deciduous (*Populus tremuloides*) codominant.. MIXED-NARROW-LEAVED EVERGREEN AND BROAD-LEAVED DECIDUOUS Subclass, Lodgepole-Aspen d.t.

(a) *Rosa woodsii* and *Potentilla fruticosa* common..... Rowo-Pofr Phase

(b) Tall Willows and *Juniperus communis* common..... Tall Willow-Juco Phase

(c) Tall Willows common..... Tall Willow Phase

3. Narrow-leaved evergreens dominant..... NARROW-LEAVED EVERGREEN Subclass (4)

Figure 2. continued

4. *Pinus contorta* var. *latifolia* and Tall Willows codominant.. Lodgepole-Tall Willow d.t.

4. *Pinus contorta* var. *latifolia*, *Juniperus communis* and sedges dominating..... Lodgepole-Juniper-Sedge d.t.

B. KEY TO SHRUB WETLAND CLASS

1. Tall willows dominating..... TALL WILLOW DOMINANT Subclass (2)

2. Habitat subdominated by sedges.. TALL WILLOW-SEDGE d.t.

(a) *Salix geyeriana* and *Carex aquatilis* common..... Sage-Caaq Phase

(b) *Salix geyeriana*, *Carex microptera* and *Carex kelloggii* common..... Sage-Cami-Cake Phase

(c) *Salix geyeriana*, *Carex aurea* and *Carex rostrata* common.. Sage-Caau-Cars Phase

(d) *Salix geyeriana*, *Salix caudata*, *Carex aquatilis* and *Carex microptera* common..... Sage-Saca-Caaq-Cami Phase

(e) *Salix caudata*, *Carex rostrata* and *Carex arvense* common..... Saca-Cars-Cavs Phase

(f) *Salix subcoerulea* and *Carex microptera* common.... Sasu-Cami Phase

2. Habitat subdominated by both dwarf willows and sedges..... TALL WILLOW-DWARF WILLOW-SEDGE d.t.

(a) *Salix geyeriana* and *Carex rostrata* common..... Sage-Cars Phase

(b) *Salix caudata* common..... Saca Phase

Figure 2. continued

(c) *Salix caudata, Salix geyeriana* and *Carex rostrata* common..... Saca-Sage-Cars Phase

(d) *Salix caudata, Salix geyeriana, Carex aquatilis* and *Carex rostrata* common..... Saca-Sage-Caaq-Cars Phase

1. Dwarf willows dominating..... DWARF WILLOW DOMINANT Subclass (3)

3. Rushes absent..... 4

4. Sedges subdominant..... DWARF WILLOW-SEDGE d.t.

(a) *Carex rostrata* common.... Cars Phase

(b) *Carex lanuginosa* common.. Cala Phase

(c) *Carex aquatilis* and *Carex microptera* common..... Caaq-Cami Phase

(d) *Carex aquatilis* and *Carex rostrata* common... Caaq-Cars Phase

(e) *Carex rostrata* and *Carex vesicaria* common.. Cars-Cavs Phase

4. Tall willows and sedges subdominant..... DWARF WILLOW-TALL WILLOW-SEDGE d.t.

(a) *Salix geyeriana* and *Carex microptera* common..... Sage-Cami Phase

(b) *Salix geyeriana* and mixed sedges common..... Sage-Mixed Sedges Phase

(c) *Salix subcoerulea, Carex rostrata* and *Carex vesicaria* common..... Sasu-Cars-Cavs Phase

(d) *Salix caudata, Carex rostrata* and *Carex vesicaria* common..... Saca-Cars-Cavs Phase

(e) *Salix caudata* and mixed sedges common..... Saca-Mixed Sedges Phase

Figure 2. continued

(f) *Salix caudata* and *Carex lanuginosa* common..... Saca-Cala Phase

(g) *Salix caudata* and *Carex microptera* common..... Saca-Cami Phase

3. Rushes present..... DWARF WILLOW-SEDGE-RUSH d.t.

C. KEY TO EMERGENT WETLAND CLASS

1. Emergent wetland plants dominated by persistent vegetation..... PERSISTENT Subclass (2)

2. Habitats dominated by sedges, rushes and grasses..... SEDGE-RUSH-GRASS d.t.

(a) *Carex rostrata* and *Juncus balticus* common..... Cars-Juba Phase

(b) *Carex microptera* and *Juncus hallii* common..... Cami-Juha Phase

(c) *Carex rostrata* and *Juncus drummondii* common..... Cars-Judr Phase

(d) *Carex microptera* and *Juncus albescens* common..... Cars-Jual Phase

(e) *Carex vesicaria*, *Carex rostrata* and *Juncus drummondii* common..... Cavs-Cars-Judr Phase

2. Habitats dominated by sedges and grasses only, rushes lacking..... SEDGE-GRASS d.t.

(a) *Carex vesicaria*, *Carex rostrata* and *Carex lanuginosa* common..... Cavs-Cars-Cala Phase

(b) *Carex rostrata* common..... Cars Phase

(c) *Carex rostrata* and *Carex lanuginosa* common..... Cars-Cala Phase

(d) *Carex vernacula* common..... Cave Phase

1. Emergent wetland plants not as above..... NON-PERSISTENT Subclass (Not present in this study)

frequency of important plants at each study site (Appendix E) and (b) dendogram of the similarity matrix between study sites based on Sorensen's K (Sorensen 1948). The latter is shown by Figure 3.

The dendogram (Figure 3) clusters the vegetation from each study site relative to their coefficient of similarity. This varies from 0.00 to 1.00 with larger values demonstrating a higher degree of similarity between study sites based on species composition within each site. When the total number of species found in each dominance type from each of the 63 study sites sampled for vegetation (data from sites 41 and 45 were missing) were used, a relatively low coefficient of similarity resulted. The highest coefficient was 0.762 (similarity coefficient between study sites WS58 and WS59). Such low coefficients should be expected since these were calculated using many species from each site. The maximum number of species by site was 65 (site 26) with a mean of 31.

Clustering of the study sites in the Forested Wetland Class was good with the exceptions of sites 26 and 28. Site 26 had a subdominant of Juniperus communis while sedges were also common. This site was endowed with 65 species of plants while study site 28 had 63 species. The presence of elements from all three classes, viz. Forest, Shrub and Emergent Wetland, strongly suggests that the site is more characteristic of an ecotone than is normally found in riparian habitats. In actual fact, these two sites represent openings in a forested wetland where

shrubs and sedges as well as upland species have invaded the area closest to the stream. This is especially true where the stream has a B gradient. In these stretches the soils tend to be sandy or sandy loam along narrow strips near the river. Late in the growing season the stream volume drops, lowering the adjacent water table, thus allowing for the invasion of some of the characteristically upland species onto the streambank area.

The Shrub Wetland class did not cluster into one or two descrete groupings, however, more numerous groups resulted. A careful analysis of the species composition of the Salix spp. and the Carex spp. (classification and Appendix E) suggests that the reason for an apparently more randomized distribution is that the species of both genera change from study site to study site with occasionally rapid changes in dominants between adjacent sites. This forms the basis for the 22 phases in 5 dominance types found in this class. Both tall and dwarf willow dominating stands tend towards A gradient streams rather than B. When this happens, the stream deposits more of its sediment load resulting in silty loam and/or clay loam soils. The water table in these areas remains high throughout the year resulting in the domination by true riparian species.

In many A gradient areas, past glacial activities (such as moraines blocking stream flow) have caused lake or pond basins to develop. As these basins filled, the soils which developed were basically deep beds of peat. These soils remain as peaty

types of soils. Often, inorganic particles are seen mixed into these peat beds while other sites seem to be dominated by decomposing organic matter only. The vegetation on such soils is most often dominated by the Emergent Wetland Class where sedge, rushes and grasses co-dominate.

Although the species numbers are below the mean (22 compared to 31) in this class, sufficient variation exists, especially in the species of rushes, to cause divergence in several of these study sites according to the cluster analysis. In these cases phase level delineation accounts for this spread.

KEY TO FIGURE 3

SYMBOL	DOMINANCE TYPE
	Aspen-Cottonwood
	Aspen
	Lodgepole-Aspen
	Lodgepole-Tall Willow
	Lodgepole-Juniper-Sedge
	Tall Willow-Sedge
	Tall Willow-Dwarf Willow-Sedge
	Dwarf Willow-Sedge
	Dwarf Willow-Tall Willow-Sedge
	Dwarf Willow-Sedge-Rush
	Sedge-Rush-Grass
	Sedge-Grass

Figure 3. Dendogram of the vegetation by study site and dominance type (symbols) showing degree of similarity between stands.

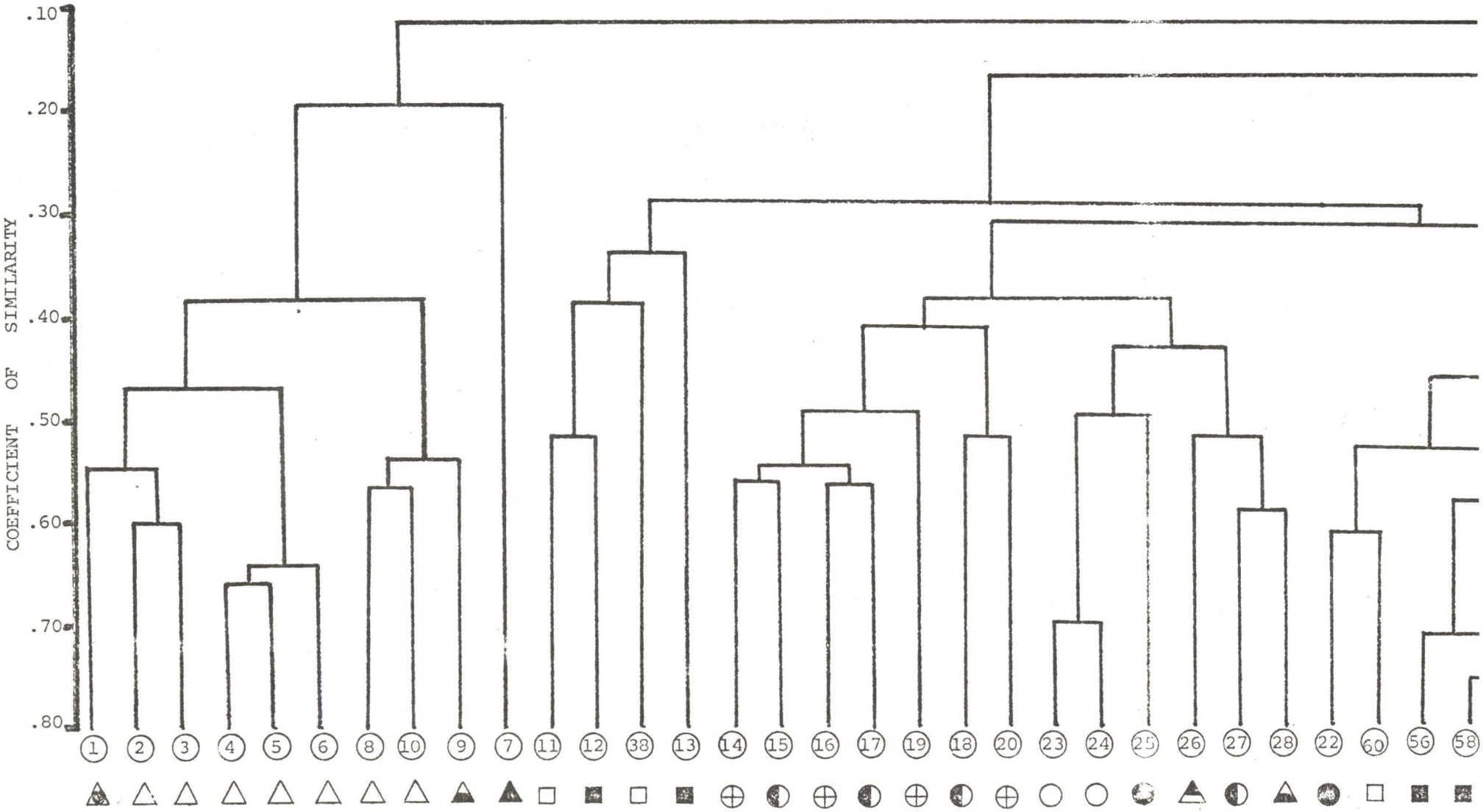
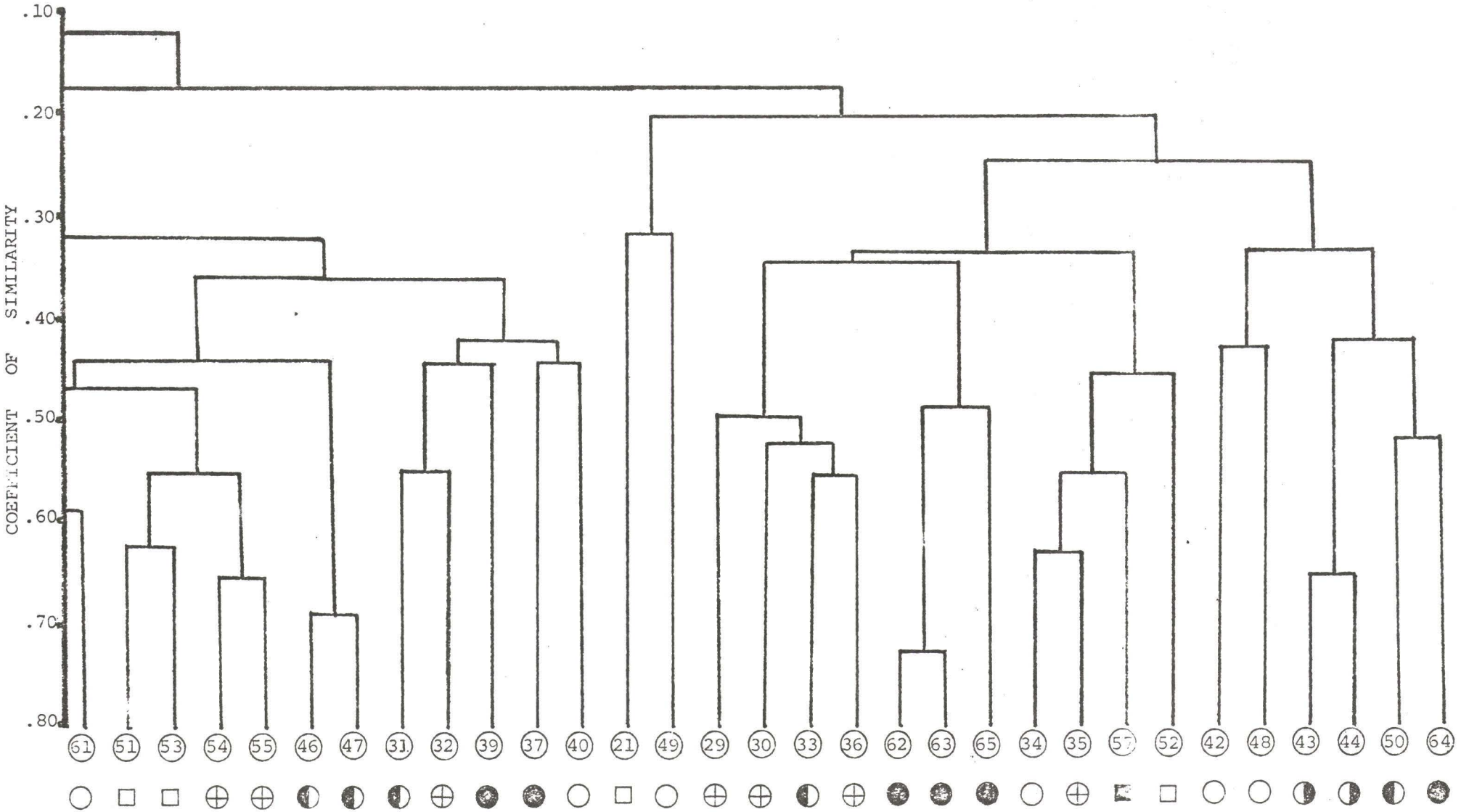


Figure 3. continued



IV. Wildlife

Reptiles and Amphibians

Only four species of amphibians and reptiles were observed. Western terrestrial garter snakes (Thamnophis elegans) were seen only below 2,550 m in elevation. Western toads (Bufo boreas) were found in all areas up to 3,300 m. Chorus frogs (Pseudacris triseriata) were observed as high as 3,000 m. A single leopard frog (Rana pipiens) was found at about 3,000 m.

Birds

Avian nomenclature follows the most recent American Ornithologists' Union classification as found in Behle and Perry (1975). Fifty-three species were counted on 65 study sites. An additional 31 species were identified in reconnaissance of other riparian areas for a total of 84 species (Appendix G). This is considerably higher than the 37 and 36 species identified in nearby lodgepole pine (Pinus contorta) stands by Winn (1976) and Austin and Perry (1979) respectively. The larger number of species in riparian areas is the result of greater patchiness and diversity of vegetation and the presence of water as compared to lodgepole forests. MacArthur (1964) showed that habitats with permanent water have higher breeding bird diversities than those without.

Most widespread species were Lincoln's Sparrow (Melospiza

lincolnii), American Robin (Turdus migratorius) and Pine Siskin (Spinus pinus) found respectively in 71%, 69% and 68% of the study sites. These three species were also the most numerous constituting 13%, 10% and 8% of all birds seen. Forty-eight of the 53 species were found in less than half of the transects and 40 species were found in less than 25% of the study sites. This is further domonstration of the patchiness of this mountain riparian system. Distribution and relative abundance of all species observed on the plots are given in Table 1. The Lincoln's Sparrow was not found by Winn (1976) in lodgepole pine communities and was observed only in meadows within lodgepole forests by Austin and Perry (1979). It appears to be dependent on low willow for nesting and has high importance values in all shrub dominated study sites (Table 2.). The other two most abundant and widespread riparian species (American Robin and Pine Siskin) were also found to be widespread and common in lodgepole forests (Winn 1976, Austin and Perry 1979).

Fourteen species were dependent upon water for feeding and thus closely tied to riparian habitats. Five of these were observed on the study sites: Mallard (Anas platyrhynchos), Sora (Porzana carolina), Spotted Sandpiper (Acetitis macularia), Common Snipe (Capella gallinago) and Dipper (Cinclus mexicanus).

Open meadows in riparian areas were utilized by several aerial foraging species: Common Nighthawk (Chordeiles minor), Barn Swallow (Hirundo rustica), Violet-green Swallow (Tachycineta thalassina) and Tree Swallow (Iridoprocne bicolor).

Table 1. Frequency of occurrence and relative abundance of birds in riparian habitat study areas of the East Fork Smiths Fork River.

Species	Percent occurrence in 65 study sites	Percent of total numbers of individuals
Mallard	10.7	1.5
Goshawk	15.4	0.8
Marsh Hawk	24.6	2.0
Red-tailed Hawk	10.7	0.5
Swainson's Hawk	9.2	0.6
Golden Eagle	1.5	0.1
Prairie Falcon	6.1	0.4
American Kestrel	4.6	0.2
Sora	1.5	0.2
Spotted Sandpiper	29.2	2.4
Common Snipe	1.5	0.1
California Gull	1.5	0.1
Mourning Dove	1.5	0.1
Common Nighthawk	9.2	0.5
Broad-tailed Hummingbird	30.8	2.4
Belted Kingfisher	3.1	0.2
Common Flicker	16.9	1.1
Yellow-bellied Sapsucker	24.6	1.5
Hairy Woodpecker	6.1	0.2
Hammond's Flycatcher	7.7	0.3
Empidonax species	13.8	0.8
Olive-sided Flycatcher	7.7	0.3
Barn Swallow	1.5	0.1
Violet-green Swallow	9.2	0.6
Tree Swallow	36.9	3.7
Gray Jay	33.8	2.9
Mountain Chickadee	46.1	3.5
Dipper	4.6	0.3
Red-breasted Nuthatch	6.1	0.3
Brown Creeper	7.7	0.3
American Robin	69.2	8.2
Townsend's Solitaire	15.4	0.8
Hermit Thrush	13.8	0.6
Mountain Bluebird	4.6	0.2
Ruby-crowned Kinglet	15.4	1.2
Water Pipit	30.1	5.7
Warbling Vireo	21.5	1.9
Orange-crowned Warbler	6.1	0.4
Yellow-rumped Warbler	58.4	5.8
Wilson's Warbler	26.1	3.6
Red-winged Blackbird	10.8	0.6
Brewer's Blackbird	4.6	0.2
Brown-headed Cowbird	13.8	1.0
Cassin's Finch	21.5	1.4
Pine Grosbeak	21.5	1.5

Table 1. continued

Species	Percent occurrence in 65 study sites	Percent of total numbers of individuals
Black Rosy Finch	1.5	0.2
Pine Siskin	67.7	10.0
Red Crossbill	23.1	1.3
Savannah Sparrow	3.1	0.4
Dark-eyed Junco	50.8	3.6
Chipping Sparrow	23.1	3.3
White-crowned Sparrow	47.7	6.1
Lincoln's Sparrow	70.8	13.4
		N = 1718

Raptors, especially Marsh Hawks (Circus cyaneus), also foraged in open areas. Fifteen of the 85 species were dependent upon tree cavities for nest sites; five were primary cavity nesters and 10 secondary. The importance of maintaining sufficient numbers of large trees and snags for this purpose has been emphasized by Scott et al. (1977). This may be especially important in Uinta Mountain riparian zones since many areas have few trees and very few nest cavities were found in study sites even though three species of woodpeckers were observed there.

Raptors were not common; with 14 species counted, only seven were found on the study sites. No raptors were found nesting in riparian study sites but one active Goshawk (Accipiter gentilis) nest was found adjacent to one site.

Altitude was a factor in the distribution of some breeding species. The Gray Jay (Perisorius canadensis) and Water Pipit (Anthus spinoletta) were not found below 2,940 m in elevation and the Black Rosy Finch (Leucosticte australis) was not found below 3,150 m. The five most widespread species (American Robin, Yellow-rumped Warbler (Dendroica coronata), Pine Siskin, Dark-eyed Junco (Junco hyemalis) and Lincoln's Sparrow) occurred through all elevations of the drainage studied (2,536 to 3,220 m).

Relative numbers and distribution of birds by vegetation types are given in Table 2. It can be seen that some species i.e., Tree Swallow (Iridoprocne bicolor) and Yellow-rumped Warbler were of similar importance in all the vegetative

Table 2. Importance [1/] values of bird species by vegetative types in riparian areas of East Fork Smith's Fork River.

Bird species	Vegetation Classification									
	I,1	I,2	I,3	II,1,a	II,1,b	II,2,a	II,2,b	II,2,c	III,1,a	III,1,b
Sharp-shinned Hawk	-	-	-	3.14	8.66	3.70	-	-	1.84	-
Goshawk	-	3.39	-	1.75	1.45	-	2.31	9.31	1.84	5.71
Marsh Hawk	-	-	-	5.97	7.45	6.88	2.31	9.31	10.04	4.98
Red-tailed Hawk	-	0.85	-	1.41	6.64	-	-	-	-	7.61
Swainson's Hawk	10.18	2.77	-	-	6.64	-	1.15	-	1.84	4.98
Golden Eagle	-	-	-	-	-	-	1.15	-	-	-
Prairie Falcon	-	-	-	1.75	-	-	2.31	-	4.22	-
American Kestrel	-	-	-	1.41	1.45	-	-	-	-	-
Sora	-	-	-	-	-	-	-	-	2.90	-
Spotted Sandpiper	-	-	-	4.23	6.40	7.19	5.95	-	5.82	5.57
Common Snipe	-	-	-	-	-	-	-	-	2.90	-
California Gull	-	-	-	-	-	-	1.15	-	-	-
Mourning Dove	8.05	-	-	-	-	-	-	-	-	-
Common Nighthawk	-	-	4.91	3.17	1.45	-	1.49	-	-	-
Broad-tailed Hummingbird	16.21	18.03	-	4.56	3.07	6.34	1.15	-	2.37	2.49
Belted Kingfisher	-	-	-	-	3.72	-	-	-	-	3.53
Common Flicker	-	-	-	3.17	-	4.76	7.43	-	4.22	3.53
Yellow-bellied Sapsucker	14.08	12.47	-	3.27	1.45	3.59	2.31	-	-	1.91
Hairy Woodpecker	-	4.11	4.91	-	-	1.58	-	-	-	-
Hammond's Flycatcher	5.93	2.05	-	-	1.45	1.58	1.15	-	-	-
Empidonax species	-	6.17	4.91	1.41	2.26	-	2.97	-	-	-
Olive-sided Flycatcher	5.93	4.11	4.91	1.41	-	-	-	-	-	-
Barn Swallow	-	-	-	-	-	-	1.49	-	-	-
Violet-green Swallow	-	-	-	2.82	2.91	4.44	-	-	-	-
Tree Swallow	5.93	4.84	11.53	6.31	6.55	6.88	9.59	-	4.22	6.16
Gray Jay	-	-	-	10.55	7.69	4.86	9.43	11.49	8.98	9.96
Mountain Chickadee	5.93	18.03	4.91	9.49	10.36	2.43	6.10	-	13.49	16.58
Dipper	8.05	6.29	-	-	-	-	-	-	-	-
Red-breasted Nuthatch	-	-	-	2.82	-	-	-	-	1.84	7.61
Brown Creeper	-	2.77	-	1.41	-	1.58	-	-	1.84	3.80
American Robin	18.33	23.13	18.15	13.67	10.69	14.61	16.05	20.80	10.33	4.39
Townsend's Solitaire	16.21	11.13	-	1.41	-	1.58	-	-	1.84	3.80
Hermit Thrush	-	2.05	14.76	1.41	-	1.58	2.64	-	-	3.80
Mountain Bluebird	-	-	-	-	-	5.18	-	-	-	-
Ruby-crowned Kinglet	18.33	4.84	11.53	3.52	2.26	-	1.15	-	-	-
Water Pipit	-	-	-	17.79	9.31	20.01	3.97	44.71	16.69	15.85
Warbling Vireo	16.21	7.62	4.91	1.41	-	1.58	1.15	-	2.37	-
Orange-crowned Warbler	-	-	-	1.75	2.91	-	-	-	-	-
Yellow-rumped Warbler	16.21	13.8	18.15	10.52	11.74	12.06	12.07	-	8.48	11.28
Wilson's Warbler	5.93	2.77	13.23	5.95	7.36	8.71	11.25	-	6.08	-
Red-winged Blackbird	-	-	-	-	1.86	4.76	2.31	-	2.90	-
Brewer's Blackbird	-	-	-	-	-	-	2.64	-	4.22	-
Brown-headed Cowbird	-	-	-	-	3.31	5.18	4.13	-	2.37	1.91
Cassin's Finch	5.93	4.23	6.61	1.41	1.45	1.58	4.95	-	5.29	1.91
Pine Grosbeak	-	-	-	5.97	5.59	6.02	4.46	20.80	1.84	-
Black Rosy Finch	-	-	-	-	-	2.43	-	-	-	-
Pine Siskin	14.08	19.71	28.32	15.06	9.07	15.45	23.35	9.31	12.17	9.96
Red Crossbill	-	2.05	-	3.17	3.31	1.58	3.79	-	7.14	3.80
Savannah Sparrow	-	-	-	-	1.45	-	-	-	4.50	-
Dark-eyed Junco	8.05	11.13	14.72	10.20	10.11	3.17	5.28	-	13.74	19.65
Chipping Sparrow	-	-	-	3.49	7.21	-	8.43	-	15.09	21.28
White-crowned Sparrow	-	6.29	8.30	12.98	9.07	16.3	7.43	49.06	8.20	4.39
Lincoln's Sparrow	-	4.11	33.39	22.05	24.61	25.29	25.53	25.15	8.73	12.91

1/ Relative frequency + relative density (Bond 1957)

types. Whereas, the White-crowned Sparrow (Zonotrichia leucophrys) was of much higher importance in all shrub dominated types and the Chipping Sparrow (Spizella passerina) reached high importance in meadows only. Conversely, flycatchers were absent from meadows reflecting a lack of hunting perches. Table 3 compares bird species richness and diversity with various vegetative characteristics. Predicting bird species diversity (BSD) from foliage height diversity (FHD) in our study area was not successful as it was for eastern deciduous forests (MacArthur et al. 1962). All vegetative types in the Uinta riparian areas studied had higher diversities than predicted by MacArthur's technique with shrub and meadow areas having much higher diversities than predicted. Further, and also in contrast to eastern deciduous forests (MacArthur 1965), no significant correlation was found between BSD and FHD for the Uinta riparian areas ($r=0.04$, 8 d.f.). Austin (1970) and Carothers et al. (1974) also found a lack of correlation between BSD and FHD in southwestern riparian zones. Carothers et al. (1974) attributed this to the fact that many bird species using their study areas did not forage for food in the foliage. We also found no significant correlation between BSD and either percent tree canopy cover ($r=-0.05$, 8 d.f.) or percent shrub canopy cover ($r=0.16$, 8 d.f.).

Study sites clustered by similarity of avian communities are shown in Fig. 4. keyed to vegetation types. This

Table 3. Avian population and related habitat characteristics from riparian areas of the East Fork Smith's Fork River.

Vegetation Classification	Bird Species Richness	Bird Species Diversity H'	Bird Species Evenness J'	Foliage Height Diversity H'	% Tree Canopy Cover	% Shrub Canopy Cover	Mean Elevation m
I, 1	18	3.95	0.95	1.12	43.2	10.6	2711
I, 2	26	4.16	0.88	1.20	35.8	16.6	2593
I, 3	17	3.63	0.89	0.85	21.4	25.1	2778
II, 1, a	36	4.35	0.84	0.45	0.6	28.4	3067
II, 1, b	34	4.51	0.89	0.75	0.1	28.2	2975
II, 2, a	31	4.12	0.83	0.63	1.7	36.6	2983
II, 2, b	35	4.23	0.82	0.77	0.9	29.5	2910
II, 2, c	9	2.47	0.78	0.49	0	10.9	3250
III, 1, a	33	4.56	0.90	0.08	0.9	0.5	2946
III, 1, b	27	4.15	0.87	0.15	1.5	5.8	2858

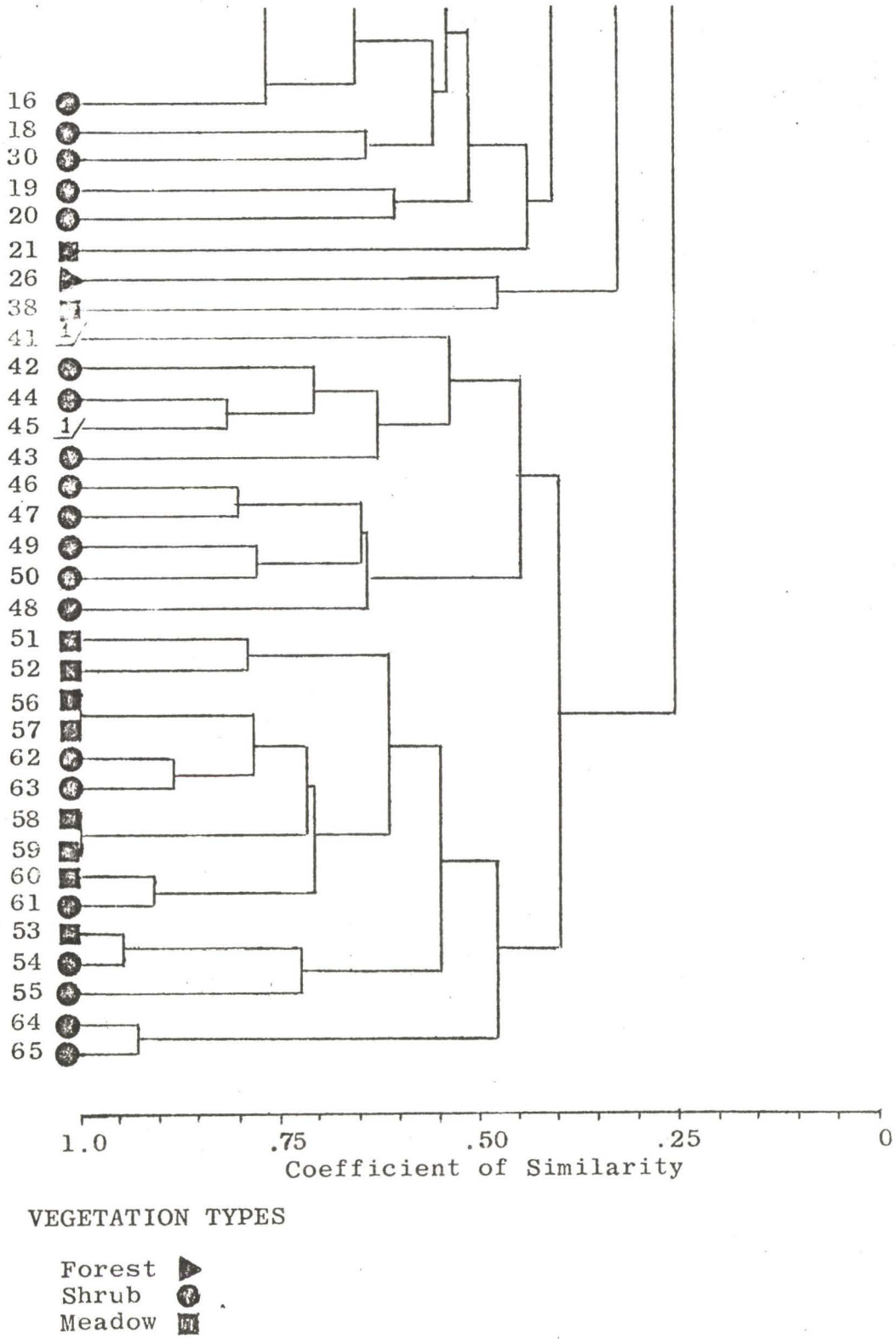


Fig. 4. Clustering of East Fork Smith's Fork River riparian areas by similarity of avian communities (numbers on left are study sites). 1/ Vegetation not classified.

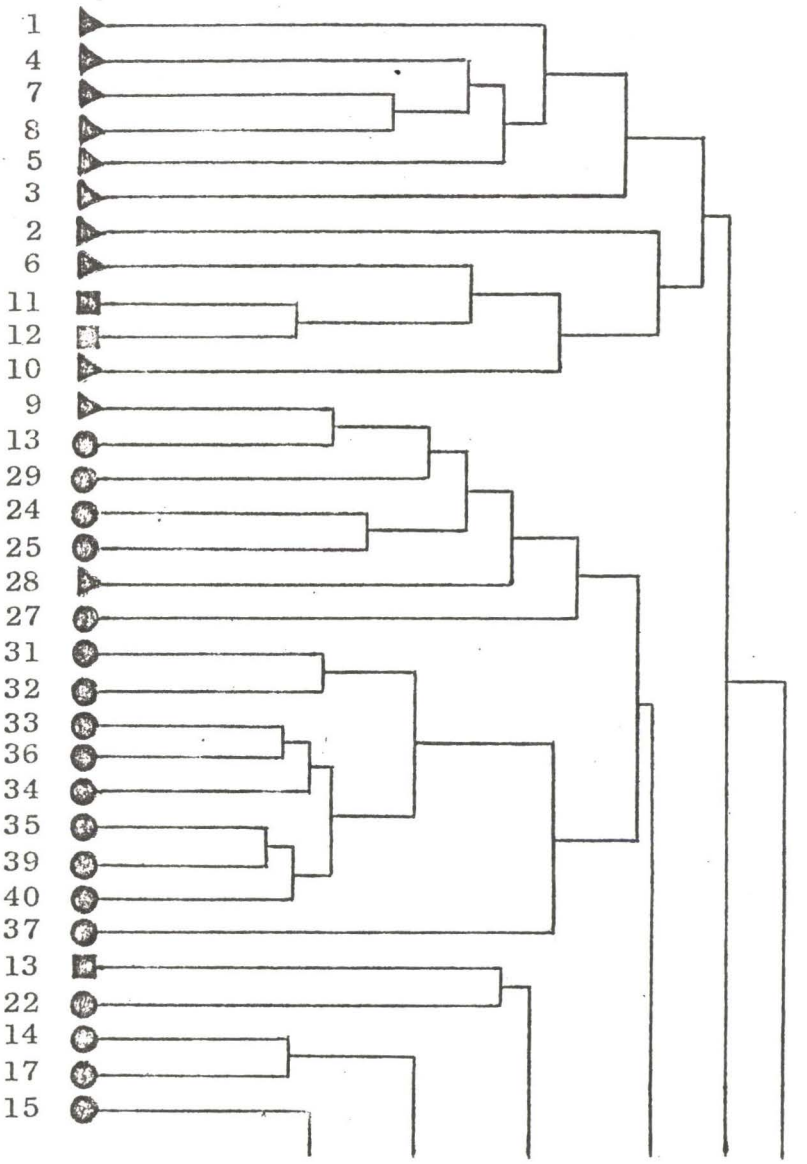


Fig. 4. Continued.

dendogram illustrates a problem in classifying bird communities in mountain riparian systems. The patchiness of the habitat creates many ecotone features and places quite different vegetative communities in close proximity. For example, site 26 is classified as a forest type but clusters with meadows and has a coefficient of similarity of only 0.30 with the next most similar forest study site. This site was adjacent to shrub and sedge dominated areas and bird species characteristic of those habitats also appeared in site 26. Sites 11, 12 and 13 are also out of place in the clustering. They were meadows surrounded by lodgepole pine forests and willow areas. Another complicating factor in this dendogram resulted from some bird species occurring only at higher elevations as breeders.

Overall, little affect of vegetation structure on avian populations was found except on species composition. Table 4 shows that when all study sites were combined into the three major vegetation types, BSD remained remarkedly constant even though FHD and percent canopy cover were considerably different. This anomaly is probably explained in that these riparian areas are essentially edge communities containing species dependent upon riparian vegetation but are also visited by many other bird species to obtain water, food or as transit areas.

Mammals

Small mammal traps were checked twice daily for a total of 12,000 trap periods in 50 study sites. Three-hundred and

Table 4. Comparison of avian population characteristics with vegetation characteristics of major habitat types in riparian areas of East Fork of Smith's Fork River.

	Vegetation Types		
	Forest (I)	Shrub (II)	Meadow (III)
Bird Species Richness	29	49	37
Bird Species Diversity (H')	4.35	4.50	4.52
Bird Species Evenness (J')	0.89	0.81	0.87
Foliage Height Diversity (H')	1.11	0.68	0.12
% Tree Canopy Cover	33.5	0.70	1.2
% Shrub Canopy Cover	17.4	26.7	3.1

eleven individuals of eight species were captured (2.6% capture success). Fifteen other species or their sign were also observed for a total of 23 mammal species (Appendix F). Data were limited due to problems with traps and accessibility of some study sites. However, some patterns are evident. Tables 5 and 6 list mammals trapped by overall frequency of occurrence and frequency in the major vegetative types. Most abundant and widespread species were the deer mouse (Peromyscus maniculatus) and montane vole (Microtus montanus). Voles were probably more abundant than indicated by trapping. Voles are usually less susceptible to trapping than deer mice. Biologists who have worked in this drainage subjectively considered voles and their sign to be much more numerous in 1979 than in several previous seasons (Jeff Grandison and Phil Wagner, pers. commun.). Voles were much more common in wetter study sites with abundant low herbaceous vegetation. Deer mice were the most common mammals in dryer, forested sites and western jumping mice (Zapus princeps) reached their highest numbers in shrub dominated vegetation types.

Data were too limited in most cases for calculating diversity indices (sample size should be >100). However, it was possible to do so for all forest types combined (H'=1.07, J'=0.73) and all shrub types combined (H'=1.94, J'=0.69).

Several small mammals found in nearby lodgepole pine forests (Winn 1976) were not trapped or observed in any riparian areas: boreal redback vole (Cleithrionomys gapperi),

Table 5. Frequency of occurrence and relative abundance of small mammals in riparian study sites of the East Fork Smiths Fork River.

Species	Percent occurrence in 50 study sites	Percent of total numbers of individuals
Shrew species (Sorex)	4.0	0.6
Golden-mantled Ground Squirrel	2.0	4.5
Least Chipmunk	14.0	4.8
Deer Mouse	32.0	41.8
Montane Vole	62.0	30.9
Richardson's Vole	10.0	2.6
Western Jumping Mouse	38.0	13.2
Short-tailed Weasel	4.0	1.6
		N = 311

Table 6. Frequency of occurrence of small mammals by vegetation types in riparian areas of East Fork Smith's Fork River.

Species	Vegetation Classification			Total
	I	II	III	Numbers
Shrew (*Sorex* species)	-	1.7 1/	-	2
Golden-mantled Ground Squirrel	8.0	-	-	14
Least Chipmunk	7.4	2.6	-	16
Deer Mouse	61.7	9.6	50.0	130
Montane Vole	14.3	54.4	40.9	96
Richardson's Vole	-	6.1	4.5	8
Western Jumping Mouse	8.6	21.6	4.5	41
Short-tailed Weasel	-	3.5	-	4
Total Numbers	175	114	22	311

1/ % occurrence

Uinta chipmunk (Eutamias umbrinus) and northern flying squirrel (Glaucomys sabrinus).

Mule deer (Odocoileus hemionus) and moose (Alces alces) were commonly observed throughout the drainage. Signs of their activity were abundant in riparian areas.

Domestic livestock were observed in much of the drainage. Cattle occurred from boundary to boundary and sheep were evident from the Lake Hessie turn off south to the Red Castle area. Meadows in the riparian zone were especially heavily grazed. In many cases the vegetation was cropped back so severely that it made identification difficult.

APPLICATION

On two separate occasions, during late September and early October, 1979, the Henrys Fork drainage was visited by riparian study team members to attempt an application of the preliminary vegetation classification which had been drafted on the basis of field studies along the East Fork Smiths Fork drainage. At this point, however, the classification which had been developed contained only the classes, subclasses and a few dominance types. Refinement into more extensive dominance types and phase levels was done only after further analyses of the field data, including recent computer analyses, the results of which were not available for this field-test of usefulness exercise.

Only those portions of the Henrys Fork drainage which were accessible were observed. Recognizing that this was an extremely late time of year for such studies, especially any involving plant species identification, as much of the drainage as possible was observed by driving near the riparian habitats and hiking into sites for some cursory sampling of the vegetation and soils. Insufficient time and the lateness of the season made avian and mammalian studies nearly impossible.

Henrys Fork drainage, like most of those on the north slope of the Uinta Mountains, has been extensively glaciated. This drainage, however, appeared to be comparatively younger than East Fork Smiths Fork with concomitantly less development of soils and less extensive terminal and lateral moraines. This may have a bearing on the resultant soils and vegetation throughout the drainage. The upper reaches were not studied, however, and there may well have been areas more comparable to East Fork

Smiths Fork. The lower reaches which were investigated were characterized by a stream which was smaller with steeper and rockier sides than the East Fork Smiths Fork River. Some obvious differences in the vegetation in the two drainages exist.

Two sections of Henrys Fork drainage were observed as to their vegetation and soils. The first section was located approximately one mile above the trailhead where the stream had a B gradient; soils were well-drained, sandy, and poorly developed; and the dominant plant was lodgepole pine (Lodgepole pine-Tall willow dominance type). Where the vegetation appeared to be richer in sedges and grasses, we found considerable beaver activity which accounted for deeper soils and a wider bottomland unit. Here too could be found some tall willows, Rubus and Potentilla. The willows were very heavily browsed in this area indicating considerable big game animal utilization. Moose fecal pellets were commonly found in this area.

The second section was located approximately five miles downstream from the first section where the stream had an A gradient. Here soils were better developed silty loam, less well-drained with an excellent water holding capacity and having a varied A horizon (indicating flood deposition). The dominant plants were sedges and grasses, the sedges being very heavily overgrazed. Unfortunately, we could not go beyond the sedge-grass dominance type and classify this community on the basis of phase type because the sedges could not be identified to species.

In comparing the riparian vegetation of both drainages it becomes obvious that Henrys Fork can be characterized by having a striking absence of the emergent wetland class of vegetation. The forested wetland and shrub wetland classes are, however, present. Of the latter two classes, those in the riparian habitats of Henrys Fork were better and less developed respectively. These less developed willow dominated communities as well as the complete absence of sedge and grass dominated meadows probably reflect the younger age of the drainage and their concomitantly poorer development of soils.

RECOMMENDATIONS

A. For Future Research

1. Goals and objectives of the research should be clearly defined at the outset of future studies.
2. Sufficient time must be allowed at the outset of future studies to adequately survey the literature, develop acceptable methodologies, develop an appropriate manpower needs assessment and train personnel in special skill requiring tasks. Eg. to adequately define the valley bottomland units and their vegetation from aerial photographs considerable expertise and skill is required. Most often the Forest Service has that expertise and skill which institutions, such as W.S.C., do not have.
3. The riparian communities, especially high elevation ones, are <u>not</u> homogeneous in nature, but rather somewhat belted or made up of irregular mosaics of communities with ecotones between. It thus becomes imperative that methodologies recommended for vegetative sampling or animal species censusing not be borrowed from sources where homogeneous stands are a requisite for the use or refinement of the methodology. (Eg. the limitations of the Cottam and Curtis (1956) point-quarter method for selection of trees is obvious).
4. Future studies should strongly consider a geomorphologist as a team member. His/her expertise could be extremely valuable, especially early in the research when study

sites are selected and attempts to take into account the geologic history of the area are made.

5. Upland soils adjacent to the riparian study sites should be studied. By way of contrast such data could give a clue as to the history of a given site and specifically what kind of succession has been taking place.
6. Bird counts do not need to end by 0900. Such census work can probably extend throughout the morning since it remains cool in high mountain areas. Very early bird counts may miss some insect feeders, especially those that are aerial foragers.
7. Quantitative assessment of livestock grazing is needed, possibly through the use of exclosures.
8. Quantitative assessment of big game use is also needed, at least through pellet counts.
9. Small mammal trapping is of limited value on quick classifications. Problems arise where the area to be studied lies far from a road. Packing a sufficient number of live traps (especially non-folding, steel types) becomes a limiting factor. Snap traps could be used to give an assessment of what species are present.
10. Careful attention should be given herbage production measurements: We failed to separate these into the three categories of grass, forbs, and browse. The measurements obtained, however, were extremely variable

as to ratio of air-dry weight to green fresh weight, and thus difficult to apply to the green weights estimated or actually weighed.

11. Vegetative data which includes only presence or frequency of species are insufficient. From our 30, m^2 plots at the study site only presence data were taken. Numbers of individual plants were missing. The three parameters; density, frequency and dominance, would be useful in determining importance values of species in the community. Special consideration should be given when planning such vegetative sampling in emergent wetland communities.
12. Any application and/or field-testing of any riparian vegetation classification system in a new drainage should be conducted during the most appropriate and comparable time of year to when the data were gathered for the initial classification.
13. Studies on carrying capacities for grazing animals in riparian habitats is essential future research.

B. For Management

1. Eliminate or drastically reduce grazing by domestic animals in all riparian plant communities, especially at high elevations. If grazing must exist, then the impacts must be more carefully monitored. Channel banks are highly succeptible to livestock trampling. Narrow valley bottomlands, in many instances, severely

limit the distance livestock will move away from stream channels, which not only results in overgrazing, but have a negative impact on "pristine" esthetic qualities of riparian regions.

2. Require very careful control of oil-drilling operations within or adjacent to riparian plant communities (the present condition of established oil-drilling areas along Henrys Fork is not at acceptable standards of environmental protection).
3. Carefully monitor the population of moose so that severe browsing of riparian shrubs, viz. willows does not take place.
4. Determine the "carrying-capacity" of campers in riparian communities and reduce recreational use where appropriate. Restraint should be exercised in regard to over-developing road-dependent recreational facilities in sensitive riparian areas, even when roading potential exists. If this is not done, then at a minimum, prohibit the use of off-road vehicles in these regions.
5. Maintain high aesthetic values of riparian regions for non-vehicular recreation. Such recreation, in the upper reaches of East Fork Smiths Fork, is seriously altered by encounters with large flocks of sheep which leave

behind "ominous olfactory offensive offal" and an increased opportunity for contracting Girardiasis. This is not especially conducive to a wilderness experience (even though this area is only a "de facto" wilderness).

6. Maintain high watershed values of riparian regions by prohibiting development in the valley bottomland and grazing everywhere. Several of our study sites which began as truly riparian with adequate ground cover ended up as sand-blown sites with as little as 5-10% ground cover following excessive grazing by sheep. This is completely incompatible with sound watershed management.

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Appendix A Stream, Riparian and Valley Bottomland Parameters of East Fork Smiths Fork, Utah

STUDY SITE	VALLEY BOTTOMLAND WIDTH (m)	RIPARIAN TO TOESLOPE DISTANCE (m)	STUDY SITE TO STREAM DISTANCE (m)	STREAM ORDER	STREAM WIDTH & DEPTH (m)		SINUOSITY RATIO I: X	CHANNEL STABILITY	DOMINANT STREAM BOTTOM MATERIAL	COBBLE IMBEDDEDNESS
					CURRENT W:D	BANKFUL W:D				
1	92	18	Adjacent	3	7.5/.3	10.5/.9	1.10	Fair	3-4	5
2	37	Adjacent	Adjacent	3	9.1/.3	10.5/.8	1.10	Fair	3-4	5
3	37	Adjacent	Adjacent	3	7/.3	9.1/1	1.10	Fair	3-4	5
4	37	Adjacent	Adjacent	3	7/.3	9.1/1	1.10	Fair	2-4	5
5	50	27	Adjacent	3	7.5/.3	10/.9	1.10	Fair	2-4	5
6	55	Adjacent	Adjacent	3	6/.5	14/1	1.10	Fair	2-4	5
7	73	Adjacent	Adjacent	3	5.5/.3	30.5/1.5	1.10	Fair	2-4	5
8	73	27	Adjacent	3	6/.5	18.2/1.2	1.10	Fair	2-4	5
9	137	46	Adjacent	3	7.5/.3	14/.9	1.10	Fair	5	4
10	227	92	Adjacent	3	6/.3	14/1.2	1.10	Fair	5	5
11	64	18	18	3	15/.2	15/.75	1.06	Fair	5	4
12	64	9	Adjacent	3	27/.2	27/.75	1.06	Fair	5	4
13	73	4.5	Adjacent	3	7.5/1	15/1.8	1.24	Good	7-8	2
14	119	27	Adjacent	3	7.5/.5	14/1.2	1.24	Fair	5	4
15	128	Adjacent	Adjacent	3	10.5/.2	10.5/.9	1.24	Fair	4-5-6	4
16	114	Adjacent	Adjacent	3	4.5/.6	10.5/1.2	1.24	Fair	4-6	4
17	110	64	Adjacent	3	9.1/.3	9.1/.75	1.24	Fair	4-5	4
18	92	27	Adjacent	3	4.5/.3	46/.75	1.24	Fair	4-5	4

Appendix , continued

TUDY ITE	VALLEY BOTTOMLAND WIDTH (m)	RIPARIAN TO TOESLOPE DISTANCE (m)	STUDY SITE TO STREAM DISTANCE (m)	STREAM ORDER	STREAM WIDTH & DEPTH (m)		SINUOSITY RATIO 1: X	CHANNEL STABILITY	DOMINANT STREAM BOTTOM MATERIAL	COBBLE IMBEDDEDNESS
					CURRENT W:D	BANKFUL W:D				
9	100	32	4.5	3	3.6/.3	9.1/.6	1.24	Fair	4-5	4
0	87	18	Adjacent	3	9.1/.5	10.5/.9	1.24	Fair	5-6	4
1	275	37	46	3	10.5/2	10.5/2.5	1.48	Good	8	1
2	227	46	27	3	14/.75	14/1.5	1.48	Good	8	1
3	114	55	Adjacent	3	12/.9	12/1.5	1.48	Good	8	1
4	82	37	Adjacent	3	12/.5	12/1	1.48	Good	8	1
5	145	69	Adjacent	3	4.5/.6	4.5/1	1.48	Fair	4-5	3
6	37	Adjacent	Adjacent	3	9/.5	9/1	1.01	Fair	5	4.5
7	46	9	Adjacent	3	10.5/.3	10.5/.75	1.07	Fair	4-5	4.5
8	46	9	Adjacent	3	10.5/.3	10.5/.75	1.07	Fair	4-5	4.5
9	55	4.5	Adjacent	3	2.5/.5	15/.9	1.07	Fair	4-5	5
0	92	37	Adjacent	3	3/.3	17/.9	1.07	Fair	4	4.5
	95	Adjacent	Adjacent	3	8/.5	9/.9	1.15	Fair	4	5
2	95	Adjacent	Adjacent	3	8/.5	9/.9	1.15	Fair	4	5
3	55	Adjacent	Adjacent	2	.6/.3	.6/.9	1.15	Fair	8	1
	55	18	Adjacent	2	.6/.3	.6/.9	1.15	Fair	8	4
	46	Adjacent	Adjacent	2	3/.3	3/.8	1.15	Fair	5	2
	46	Adjacent	Adjacent	2	3/.3	3/.6	1.15	Fair	5	2
	70	18	Adjacent	3	8/.2	8/.8	1.26	Good	5	5

Appendix A continued

TUDY ITE	VALLEY BOTTOMLAND WIDTH (m)	RIPARIAN TO TOESLOPE DISTANCE (m)	STUDY SITE TO STREAM DISTANCE (m)	STREAM ORDER	STREAM WIDTH & DEPTH (m)		SINUOSITY RATIO I: X	CHANNEL STABILITY	DOMINANT STREAM BOTTOM MATERIAL	COBBLE IMBEDDEDNESS
					CURRENT W:D	BANKFUL W:D				
8	55	27	Adjacent	3	8/.3	8/.8	1.26	Good	5	5
9	37	9	Adjacent	3	6/.4	7/.8	1.26	Good	4-5	5
0	40	18	Adjacent	3	8/.3	8/.6	1.26	Good	5	5
1	72	Adjacent	Adjacent	2	3/.9	3/1.2	1.08	Good	4	4
2	95	Adjacent	Adjacent	2	2/.9	3/1.2	1.08	Good	5	4
3	145	70	Adjacent	2	2.4/1	2.8/1.2	1.08	Good	4-5	4
4	140	42	Adjacent	2	2.1/1	2.4/1.2	1.08	Good	5	4
5	145	38	Adjacent	2	3.0/1	3/1.2	1.08	Good	5	4
6	183	27	Adjacent	2	4.6/1.2	4.6/1.4	1.37	Fair	8	1
7	183	32	Adjacent	2	6/1.2	6/1.4	1.37	Fair	8	1
8	183	88	Adjacent	2	6/1.2	6/1.5	1.37	Fair	8	1
9	183	72	Adjacent	2	4.6/1.2	6/1.4	1.37	Fair	7	1
0	183	72	Adjacent	2	4.6/1.2	4.6/1.5	1.37	Fair	7	1
1	73	18	Adjacent	3	6/1.2	6/1.7	1.42	Good	6	3
2	100	37	Adjacent	3	7.5/1	7.5/1.5	1.42	Good	7	1
3	91	64	Adjacent	3	10.7/1	10.7/1.7	1.42	Good	5	3
4	274	73	Adjacent	3	4.6/.8	4.6/1.4	1.42	Good	8	3
5	274	82	Adjacent	3	5.2/1.4	5.2/1.8	1.42	Good	8	2
6	91	18	Adjacent	3	6/2.4	6/3	1.42	Fair	Water too turbid	2 est.

Appendix A continued

STUDY SITE	VALLEY BOTTOMLAND WIDTH (m)	RIPARIAN TO TOESLOPE DISTANCE (m)	STUDY SITE TO STREAM DISTANCE (m)	STREAM ORDER	STREAM WIDTH & DEPTH (m)		SINUOSITY RATIO	CHANNEL STABILITY	DOMINANT STREAM BOTTOM MATERIAL	COBBLE IMBEDDEDNESS
					CURRENT W:D	BANKFUL W:D				
57	91	9	18	3	6/2.4	6/3	1.42	Fair	Too turbid 2 est.	
58	69	18	Adjacent	3	9/.6	9/1.5	1.42	Fair	8	3
59	55	9	Adjacent	3	4.6/.6	4.6/1.8	1.42	Fair	7-8	3
60	100	37	Adjacent	3	3.6/1.2	3.6/2.4	1.42	Fair	7	3
61	100	41	Adjacent	3	3.6/1.2	3.6/2.4	1.42	Fair	8	3
62	91	9	Adjacent	3	2.4/1.5	2.4/2.4	1.42	Fair	8	3
63	91	9	Adjacent	3	2.4/1.5	2.4/2.4	1.42	Fair	6	2
64	91	9	Adjacent	3	2.4/1.5	2.4/2.4	1.42	Fair	8	3
65	91	18	Adjacent	3	2.5/1.5	2.5/2.5	1.42	Fair	7	3.5

Appendix B

SOIL FAMILIES FOR STUDY SITES ON EAST FORK SMITHS FORK

1. Typic cryaquoll, coarse loamy, mixed, non-acid, shallow
2. Typic cryaquent, loamy skeletal, mixed, non-acid, shallow
3. Typic cryaquent, sandy skeletal, mixed, non-acid, micro
4. Typic cryaquent, loamy skeletal, mixed, non-acid, micro
5. Typic cryaquent, sandy skeletal, mixed, non-acid, micro
6. Typic cryaquent, sandy skeletal, mixed, non-acid, micro
7. Typic cryaquoll, coarse loamy, mixed, non-acid, shallow
8. Typic cryaquent, sandy skeletal, mixed, non-acid, micro
9. Typic cryaquent, fine loamy, mixed, non-acid, shallow
10. Typic cryaquent, sandy skeletal, mixed, non-acid, micro
11. Typic cryaquoll, fine loamy, mixed, non-acid
12. Typic cryaquoll, coarse loamy, mixed, non-acid
13. Typic cryaquoll, fine silty, mixed, non-acid
14. Typic cryaquoll, fine silty, mixed, non-acid, shallow
15. Typic cryaquoll, fine silty, mixed, non-acid, shallow
16. Typic cryaquent, coarse loamy, mixed, non-acid, shallow
17. Typic cryaquoll, fine loamy, mixed, non-acid
18. Typic cryaquent, sandy skeletal, mixed, non-acid, micro
19. Typic cryaquoll, coarse silty, mixed, non-acid, shallow
20. Typic cryaquoll, coarse loamy, mixed, non-acid, shallow
21. Typic cryaquoll, fine silty, mixed, non-acid
22. Typic cryaquoll, fine silty, mixed, non-acid
23. Typic cryaquoll, coarse silty, mixed, non-acid
24. Typic cryaquoll, coarse silty, mixed, non-acid
25. Typic cryaquent, coarse silty, mixed, non-acid, shallow
26. Typic cryaquent, coarse loamy, mixed, non-acid
27. Typic cryaquent, fine loamy, mixed, non-acid, micro

28. Typic cryaquoll, fine loamy, mixed, non-acid
29. Typic borofibrist, clayey, mixed, euic
30. Typic cryaquoll, coarse loamy, mixed, non-acid
31. Typic cryaquoll, fine silty, mixed, non-acid
32. Typic borofibrist, ferrihumic, euic, micro
33. Agric cryaquoll, fine silty, mixed, non-acid
34. Typic borofibrist, clayey, mixed, euic
35. Typic cryaquoll, fine silty, mixed, non-acid
36. Agric cryaquoll, fine silty, mixed, non-acid, shallow
37. Typic cryaquoll, fine silty, mixed, non-acid, shallow
38. Typic cryaquent, sandy skeletal, mixed, non-acid, micro
39. Typic cryaquoll, coarse loamy, mixed, non-acid, shallow
40. Typic cryaquoll, coarse loamy, mixed, non-acid
41. Typic cryaquent, fine silty, mixed, acid, micro
42. Typic cryaquent, coarse silty, mixed, non-acid, micro
43. Typic borofibrist, clayey, mixed, euic
44. Typic borofibrist, (water saturated)
45. Typic borofibrist, loamy, mixed , euic, micro
46. Typic borofibrist, loamy, mixed,euic
47. Agric cryaquoll, fine silty, mixed, acid
48. Typic borofibrist, clayey, mixed,euic
49. Typic borofibrist (water saturated)
50. Typic borofibrist (water saturated)
51. Agric cryaquoll, coarse silty, mixed, acid
52. Typic cryaquoll, fine silty, mixed, non-acid
53. Typic cryaquoll, fine silty, mixed, acid
54. Typic cryaquent, coarse silty, mixed, non-acid, micro
55. Typic cryaquent, coarse silty, mixed, non-acid, micro

56. Typic cryaquoll, coarse silty, mixed non-acid
57. Typic borofibrist, clayey, mixed, euic
58. Typic cryaquoll, fine silty, mixed, non-acid
59. Agric cryaquoll, fine loamy, mixed, non-acid
60. Typic cryaquoll, fine silty, mixed, acid
61. Typic cryaquoll, fine silty, mixed, acid
62. Typic cryaquoll, fine silty, mixed, non-acid
63. Typic cryaquoll, fine loamy, mixed, non-acid
64. Typic borofibrist, clayey, mixed, euic
65. Typic cryaquoll, fine silty, mixed, non-acid

Appendix C

Laboratory analysis of soil samples taken from the A horizons of soil pits dug along East Fork Smiths Fork River

Study Site	Munsell Colors	Color Names	Textural Class
1	5YR 4/2 (dry) 5YR 2/2 (moist)	dark reddish gray dark reddish brown	sandy loam
2	5YR 4/2 (dry) 5YR 2/2 (moist)	dark reddish gray dark reddish brown	sandy loam
3	5YR 4/2 (dry) 5YR 2/2 (moist	dark reddish gray dark reddish brown	sandy loam
4	5YR 4/2 (dry) 5YR 2/2 (moist)	dark reddish gray dark reddish brown	sandy loam
5	5YR 5/2 (dry) 5YR 3/2 (moist)	reddish gray dark reddish brown	sandy loam
6	5YR 5/2 (dry) 5YR 3/2 (moist)	reddish gray dark reddish brown	sandy loam
7	5YR 5/2 (dry) 5YR 3/2 (moist)	reddish gray dark reddish brown	fine sandy loam
8	5YR 5/3 (dry) 5YR 3/3 (moist)	reddish brown dark reddish brown	fine sandy loam
9	5YR 4/2 (dry) 5YR 2/1 (moist	dark gray black	loam
10	5YR 5/3 (dry) 5YR 3/3 (moist)	reddish brown dark reddish brown	loamy sand
11	5YR 3/1 (dry) 5YR 2/1 (moist)	very dark gray black	loam
12	5YR 5/2 (dry) 5YR 3/2 (moist)	reddish gray dark reddish brown	sandy loam
13	5YR 5/3 (dry) 5YR 3/3 (moist)	reddish brown dark reddish brown	clay loam
14	5YR 5/3 (dry) 5YR 3/3 (moist)	reddish brown dark reddish brown	clay loam
15	5YR 3/1 (dry) 5YR 2/1 (moist)	very dark gray black	clay loam
16	5YR 5/2 (dry) 5YR 3/2 (moist)	reddish gray dark reddish brown	sandy loam
17	5YR 5/3 (dry) 5YR 3/3 (moist)	reddish brown dark reddish brown	loam

18	5YR 4/2 (dry) 5YR 2/2 (moist)	dark reddish gray dark reddish brown	silt loam
19	sample missing		
20	5YR 4/2 (dry 5YR 2/2 (moist)	dark reddish gray dark reddish brown	sandy loam
21	5YR 4/2 (dry) 5YR 2/2 (moist)	dark reddish gray dark reddish brown	clay loam
22	5YR 4/2 (dry) 5YR 2/2 (moist)	dark reddish gray dark reddish brown	clay loam
23	5YR 4/2 (dry) 5YR 2/2 (moist)	dark reddish gray dark reddish brown	silt loam
24	5YR 4/3 (dry) 5YR 3/3 (moist)	reddish brown dark reddish brown	silt loam
25	5YR 4/2 (dry) 5YR 2/2 (moist)	dark reddish gray dark reddish brown	silt loam
26	5YR 5/3 (dry) 5YR 3/3 (moist)	reddish brown dark reddish brown	sandy loam
27	5YR 4/2 (dry) 5YR 2/2 (moist)	dark reddish gray dark reddish brown	loam
28	5YR 5/3 (dry) 5YR 3/3 (moist)	reddish brown dark reddish brown	loam
29	Organic soil		
30	5YR 4/3 (dry) 5YR 3/3 (moist)	reddish brown dark reddish brown	sandy loam
31	5YR 5/1 (dry) 5YR 3/1 (moist)	gray very dark gray	clay loam
32	Organic soil		
33	5YR 5/2 (dry) 5YR 3/2 (moist)	reddish gray dark reddish gray	silty clay
34	Organic soil		
35	5YR 4/2 (dry) 5YR 2/2 (moist)	dark reddish gray dark reddish brown	clay loam
36	Organic soil		
37	5YR 3/2 (dry) 5YR 2/2 (moist)	dark reddish brown dark reddish brown	sandy clay

38	5YR 4/3 (dry) 5YR 3/3 (moist)	reddish brown dark reddish brown	sandy loam
39	5YR 5/3 (dry) 5YR 3/3 (moist)	reddish brown dark reddish brown	sandy loam
40	5YR 4/3 (dry) 5YR 3/3 (moist)	reddish brown dark reddish brown	sandy loam
41	5YR 5/2 (dry) 5YR 3/2 (moist	reddish gray dark reddish gray	clay loam
42	7.5YR 4/2 (dry) 7.5YR 3/2 (moist)	brown dark brown	silt loam
43	Organic soil		
44	Organic soil		
45	Organic soil		
46	Organic soil		
47	5YR 5/3 (dry) 5YR 3/3 (moist)	reddish brown dark reddish brown	clay loam
48	Organic soil		
49	Organic soil		
50	Organic soil		
51	5YR 4/3 (dry) 5YR 3/3 (moist)	reddish brown dark reddish brown	silt loam
52	5YR 5/3 (dry) 5YR 3/3 (moist)	reddish brown dark reddish brown	clay loam
53	5YR 5/3 (dry) 5YR 3/3 (moist)	reddish brown dark reddish brown	clay loam
54	5YR 5/2 (dry) 5YR 3/2 (moist)	reddish gray dark reddish brown	silt loam
55	5YR 5/2 (dry) 5YR 3/2 (moist)	reddish gray dark reddish brown	silt loam
56	5YR 5/3 (dry) 5YR 3/3 (moist)	reddish brown dark reddish brown	silt loam
57	Organic soil		

58	5YR 5/3 (dry) 5YR 3/3 (moist)	reddish brown dark reddish brown	clay loam
59	5YR 5/3 (dry) 5YR 3/3 (moist)	reddish brown dark reddish brown	loam
60	5YR 5/3 (dry) 5YR 3/3 (moist)	reddish brown dark reddish brown	silt loam
61	5YR 5/3 (dry) 5YR 3/3 (moist)	reddish brown dark reddish brown	silt loam
62	5YR 5/3 (dry) 5YR 3/3 (moist)	reddish brown dark reddish brown	silt loam
63	5YR 5/3 (dry) 5YR 3/3 (moist)	reddish brown dark reddish brown	loam
64	Organic soil		
65	5YR 5/1 (dry) 5YR 3/1 (moist)	gray very dark gray	clay loam

Appendix D

Checklist of Seed Plants-Riparian Study East Fork Smiths Fork

Abla	Abies lasiocarpa	Subalpine fir
Acmi	Achillea millefolium	Yarrow
Agba	Agropyron bakeri	Baker wheatgrass
Aggl	Agoseris glauca	Pale agoseris
Agid	Agropyron idahoensis	Idaho wheatgrass
Agsc	Agrostis scabra	Rough bentgrass
Agsu	Agropyron subsecundum	Bearded wheatgrass
Agtr	A. trachycaulum	Slender wheatgrass
Agva	Agrostis variabilis	Bentgrass
Alae	Alopecurus aequalis	Shortawn foxtail
Aldi	Allium diehlii	Wild onion
Ampu	Amelanchier pumila	Service berry
Anal	Antennaria alpina	Alpine pussytoes
Anpi	Angelica pinnata	Angelica
Anrs	Antennaria rosea	Rose pussytoes
Anse	Androsace septentrionalis	Pigmy rockjasmine
Arcn	Arenaria congesta	Ballhead sandwort
Arco	Arnica cordifolia	Heartleaf arnica
Arlo	A. longifolia	Longleaf arnica
Armo	A. mollis	Hairy arnica
Arru	Arenaria rubella	Sandwort
Arsc	Artemisia scopulorum	Alpine sagebrush
Artr	A. tridentata	Big sagebrush
Aruv	Arctostaphylos uva-ursi	Bearberry
Asmi	Astragalus miser	Weedy milkvetch
Bere	Berberis repens	Creeping barberry
Bran	Bromus anomalus	Nodding brome
Brca	B. carinatus	Mountain brome
Brin	B. inermis	Smooth brome
Caaq	Carex aquatilis	Water sedge
Caau	C. aurea	Golden sedge
Caca	Calamagrostis canadensis	Bluejoint reedgrass
Caco	Carex canescens	Pale sedge
Cacp	C. capillaris	Hairlike sedge
Cafe	C. festivella	Ovalhead sedge
Cage	Carex geyeri	Elk sedge
Cake	C. kelloggii	Kellogg sedge
Cala	C. lanuginosa	Woolly sedge
Cale	Caltha leptosepala	Elkslip marsh marigold
Cami	Carex microptera	Smallwing sedge
Cane	Calamagrostis neglecta	Slimstem reedgrass
Cano	Carex nova	Sedge
Caoc	Castilleja occidentalis	Western painted-cup
Capa	Campanula parryi	Parry bellflower
Caph	Carex phaeocephala	Dunhead sedge
Caps	C. pseudoscirpoidea	Sedge
Capu	Calamagrostis purpureus	Purple pinegrass
Carh	Castilleja rhexifolia	Splitleaf painted-cup
Caro	Carex rossii	Ross sedge
Cars	Carex rostrata	Beaked sedge
Cart	Campanula rotundifolia	Bluebell

Casp	Carex sp.	Sedge
Cave	Carex vernacula	Alpine blackheaded sedge
Cavs	C. vesicaria	Blister sedge
Cear	Cerastium arvense	Starry cerastium
Cifo	Cirsium foliosum	Elk thistle
Clla	Claytonia lanceolata	Spring beauty
Dain	Danthonia intermedia	Timber danthonia
Deci	Deschampsia intermedia	Hairgrass
Dene	Delphinium nelsonii	Nelson larkspur
Deri	Descurainea richardsonii	Richardson tansymustard
Doal	Dodecatheon alpinum	Alpine shootingstar
Drre	Draba reptans	Carolina draba
Drst	D. stenoloba	Alaska draba
Epal	Epilobium alpinum	Alpine willowweed
Epan	Epilobium angustifolium	Fireweed
Eqar	Equisteum arvense	Field horsetail
Erac	Erigeron acris	Bitter fleabane
Erpe	E. peregrinus	Peregrine fleabane
Erru	Eriogonum rubricaule	Red wild buckwheat
Ersp	Erigeron sp.	Fleabane
Erum	Eriogonum umbellatum	Sulfur eriogonum
Feob	Festuca ovina var. bracyphylla	Alpine fescue
Feor	F. ovina var. rydbergii	Rydberg fescue
Fram	Fragaria americana	Wild strawberry
Gabo	Galium boreale	Northern bedstraw
Gatr	G. trifidum	Small bedstraw
Geba	Gentiana barbellata	Gentian
Gefr	G. fremontii	Fremont gentian
Geri	Geranium richardsonii	Richardson geranium
Gero	Geum rosii	Golden avens
Gete	Gentiana tenella	Gentian
Giag	Gilia aggregata	Gilia
Hiod	Hierchloe odorata	Sweetgrass
Hygr	Hymenoxys grandiflora	Graylocks hymenoxys
Jual	Juncus albescens	Rush
Juba	J. balticus	Baltic rush
Juco	Juniperus communis	Mountain common juniper
Judr	Juncus drummondii	Drummond rush
Juha	J. hallii	Halls rush
Jume	J. mertensianus	Mertens rush

Lala	Lathyrus lanszwertii	Thickleaf peavine
Legl	Ledum glandulosum	Western ledum
Lepy	Lewisia pygmaea	Least lewisia
Lipe	Linum lewisii	Lewis flax
Lite	Ligusticum tenuifolium	Slender-leafed ligusticum
Litl	Lithophragma tenella	Slender woodland star
Loin	Lonicera involucrata	Bearberry honeysuckle
Luco	Luzula comprestis	Woodrush
Lupa	L. parviflora	Millet woodrush
Luwy	Lupinus wyethia	Lupine
Meba	Mertensia bakeri	Blue bells
Meci	M. ciliata	Mountain blue bells
Mile	Mimulus lewisii	Lewis monkeyflower
Moss	(Moss)	
Pamy	Pachistima myrsinites	Mountain lover
Pegr	Pedicularis groenlandica	Elephanthead lousewort
Pepa	Penstemon palmeri	Palmer penstemon
Peui	P. uintahensis	Uinta penstemon
Pewh	P. whippleanus	Whipple penstemon
Phal	Phleum alpinum	Alpine timothy
Phca	Phlox caespitosus	Phlox
Phmu	P. multiflora	Flowery phlox
Phse	Phacelia sericea	Silky phacelia
Picl	Pinus contorta var. latifolia	Lodgepole pine
Pien	Picea engelmannii	Englemann spruce
Plpu	Plantago patagonica	Wooly plantain
Poal	Poa alpina	Alpine bluegrass
Poan	Populus angustifolium	Narrowleaf cottonwood
Pobi	Polygonum bistortoides	American bistort
Pobu	Poa bulbosa	Bulbous bluegrass
Podi	Potentilla diversifolia	Varieleaf cinquefoil
Pofe	Poa fendleriana	Mutton bluegrass
Pofr	Potentilla fruticosa	Bush cinquefoil
Pogr	Poa gracillima	Slender bluegrass
Pole	P. leptocoma	Bog bluegrass
Pose	P. secunda	Sandberg bluegrass
Posp	P. sp.	Bluegrass
Potr	Populus tremuloides	Quaking aspen
Povi	Polemonium viscosum	Sticky polemonium
Povv	Polygonum viviparum	Viviparous bistort
Prpa	Primula parryi	Parry primrose
Putr	Purshia tridentata	Bitterbrush
Raal	Ranunculus alismaefolium	Dwarf plainleaf buttercup
Ripa	Ribes aureum	Golden currant
Rowo	Rosa woodsii	Woods rose

Saca	Salix caudata	Whiplash willow
Saex	S. exigua	Dusky willow
Sage	S. geyeriana	Geyer willow
Sani	S. nivalis	Snow willow
Saps	S. pseudolapponum	Willow
Sasu	S. subcoerulea	Willow
Sawo	S. wolfii	Wolfs willow
Sein	Senecio integerrimus	Lambstongue groundsel
Serh	Sedum rhodanthum	Redpod stonecrop
Sesp	Senecio spartioides	Broom groundsel
Sest	Sedum stenopetalum	Wormleaf stonecrop
Setr	Senecio triangularis	Arrowleaf groundsel
Smst	Smilicina stellata	Starry Solomonplume
Soci	Solidago ciliosa	Goldenrod
Stja	Stellaria jamesiana	Tuber starwort
Stpi	Stipa pinetorum	Pinewoods needlegrass
Swpe	Swertia perennis	Alpinebog swertia
Syra	Symphoricarpos racemosus	Snowberry
Taof	Taraxacum officinale	Common dandelion
Thal	Thalictrum alpinum	Alpine meadowrue
Thap	Thlaspi alpestre	Field pennycress
Thfe	Thalictrum fendleri	Fendler meadowrue
Thmo	Thermopsis montana	Mountain thermopsis
Thsp	Thalictrum sparsiflorum	Meadowrue
Trda	Trifolium dasyphyllum	Whiproot clover
Vaed	Valeriana edulis	Edible valerian
Vaer	Valeriana sp.	Valerian
Vewo	Veronica wormskjoldii	Wormskjold speedwell
Viad	Viola adunca	Hook violet
Vipa	V. pallens	Violet
Vipr	V. praemorsa	Yellow violet

Appendix E. Percentage Frequency of Important Plants, by Dominance Type and Phase

	FORESTED WETLAND CLASS							TALL WILLOW DOMINANT						
	BROADLEAVED DECIDUOUS		MIXED-EVERGREEN DECIDUOUS			NARROW-LEAVED EVERGREEN		TALL WILLOW-SEDGE d.t.						TALL WILLO
			Picl-Potr d.t.											
NO OF STANDS	Potr Poan d.t. 1	Potr d.t. 1	Rowo-Pofr Phase 5	Tall salix-Juco Phase 1	Tall Salix Phase 1	Picl Tall Salix d.t. 2	Picl Juco Carex d.t. 1	Sage Caaq Phase 2	Sage Cami Cake Phase 2	Sage Cacu Cars Phase 1	Sage Saca Caaq Cami Phase 1	Saca Cars Cavs Phase 1	Sasu Cami Phase 1	Sage Cars Pha 2
TREES														
Picl		3.33	11.6	20.0	16.7	6.7	10.0					3.3	3.3	
Poan	13.33													
Potr	23.33	30.00	16.8	6.7	6.7									
SHRUBS														
Juco	3.33	10.00	24.8	26.7	3.3	1.6	13.3	5.0						
Pofr		13.33	18.8	40.0	3.3	31.5	6.7		5.1					
Rowo	46.67	10.00	32.8	33.3									3.3	
Saca						18.3	3.3				13.3	36.7		3.3
Sage	6.67		7.2	23.3	6.7	25.0		65.0	39.1	46.7	20.0			19.9
Sasu						13.7	6.7						63.3	
Sawo					43.3	28.5						10.0	10.0	24.9
GRAMINOIDS														
Bran														
Casp	50.00		46.2	53.3	80.0	8.5								
Caaq							3.3	76.7			56.7			
Caau							6.7		6.7	100.0		23.3	13.3	1.6
Cake									26.9					1.6
Cala											6.7	40.0	13.3	
Cami							20.0	13.3	35.6		43.3	10.0	53.3	48.5
Cars							33.0	21.7	16.7	86.7	10.0	60.0	6.7	29.9
Cave							10.0	3.3	20.9			6.7		9.4
Cavs								13.3				70.0		
Deca		6.67	0.6			23.3	6.7	25.0	42.3		70.0		30.0	34.1
Jual														
Juba			2.7	3.3										
Judr								16.7	1.6				13.3	
Juha							3.3		3.3			36.7		3.8
Phal	16.67	10.00	7.4	13.3	30.0	48.3	6.7	13.3	30.3		43.3		36.7	22.1
Poal						15.0	13.3		47.4		3.3		3.3	24.8
Pofe	16.67		6.6	16.7	6.7	16.7	33.3		33.9				6.7	3.4
Pogr						15.0	6.7	21.7	11.9		23.3			25.9
FORBS														
Acmi		23.33				28.3	60.0	5.0	56.0		66.7	10.0	67.7	45.0
Anal	6.67	40.00	18.00	6.7		8.3	13.3	15.0	20.1		36.7		50.0	33.5
Ersp	33.33		30.8	6.7	6.7	7.8								
Erpe							40.0	11.7	32.0			13.3	3.3	
Gero			1.4		3.3	3.3	10.0				13.3			
Lite			8.0		3.3	45.0	40.0	41.7	27.1		13.3	3.3	56.7	24.9
Meci			2.0			15.0	20.0		17.3		23.3		3.3	14.4
Pobi								1.5	10.1		10.0	13.3	23.3	11.3
Podi	13.33						30.0	1.5	1.5		56.7	16.7	50.0	3.5
Taof	36.67	6.67	27.2	40.0	60.0	36.7	3.3		46.0		16.7			42.1
Trda			1.2	6.7	3.3	38.3	26.7		16.8		33.3	2.0	23.3	25.0
Vewo						33.3	20.0		37.3		20.0	10.0	13.3	5.8

, In Riparian Communities Along East Fork Smiths Fork River, Utah.

SHRUB WETLAND CLASS

WILLOW-DWARF W-SEDGE d.t.			DWARF WILLOW DOMINANT										
			DWARF WILLOW-SEDGE d.t.					DWARF WILLOW-TALL WILLOW-SEDGE d.					
Saca Phase	Saca Sage Cars Phase	Saca Sage Caaq Cars Phase	Cars Phase	Cala Phase	Caaq Cami Phase	Caaq Cars Phase	Cars Cavs Phase	Sage Cami Phase	Sage Mixed Sedges Phase	Sasu Cars Cavs Phase	Saca Cars Cavs Phase	Saca Mixed Sedges Phase	Saca Cala Phase
2	3	1	4	1	2	1	1	3	1	1	2	1	1
1.5	1.1		4.2										3.3
			0.8										
			0.8										
	7.8		4.2					1.1	10.0		5.1		
28.4	44.5	26.7		3.3			6.7				35.4	30.0	40.0
3.8	11.1		8.3					24.5	13.3	16.7	41.8		
6.7	6.7		4.2							30.0			3.3
31.7	11.1	6.7	51.7	93.3	48.3	100.0	93.3	35.6	66.7	66.7	27.6	36.7	73.3
				46.7									
	26.7	86.7	1.9		55.0	86.7				13.3			
43.3			10.0	16.7				3.3					13.3
1.5			8.3						10.0		15.5		
30.0	1.1	3.3	8.3	73.3				5.3				60.0	93.3
25.0	10.0		27.5	26.7	30.0			60.0			11.7	30.0	10.0
23.3	41.1	80.0	53.4	13.3	16.7	60.0	86.7	33.3	16.7	96.7	91.6	56.7	20.0
3.3			5.0		19.5			1.3			40.3	6.7	6.7
23.7	35.6	3.3	0.8	23.3	35.0		83.3	17.8		66.7	20.7	56.7	53.3
56.6	38.9		22.5	23.3	66.7				13.3	10.0	6.9	23.3	13.3
		20.0			23.7								
								20.0	10.0				
10.0	10.0	3.3			3.4							10.0	
18.3			1.1	6.7								13.3	6.7
45.0	12.2		36.7	33.3	23.3	10.0	10.0	11.0	26.7	3.3	5.1	3.3	46.7
3.4	3.3		24.2		23.3		10.0	4.5	6.7		1.7		
5.0		10.0	8.3	13.3	3.7					6.7			
	2.2		8.3		30.0								
21.7	24.4		20.0	60.0	31.7		3.3	20.0	40.0		4.4	16.7	16.7
35.0	20.0		4.2	20.0	18.4			27.8	6.7				6.7
23.3	14.4		9.2				10.0	13.3		40.0		10.0	
3.3	17.8	3.3	20.0	10.0	5.0	6.7	10.0	38.9	33.3		10.1	3.3	
48.3	3.3		36.7	20.0	3.3		6.7	21.3	63.3	10.0	8.6	23.3	36.7
1.5	4.4	6.7	11.7	60.0	6.7		16.7	4.3	20.0	6.7	18.4	3.3	
26.7	4.3		6.4	20.0	10.0							6.7	10.0
11.8	.8		10.0	10.0	6.7		3.3	11.1	36.7				6.7
5.0	.3		12.5	6.7				14.0	23.3		3.4		3.3
18.3			15.8	6.7	30.0			7.3	16.7			3.3	3.3
33.3	3		1.9	13.3				14.2			17.2	10.0	

		EMERGENT WETLAND CLASS								
		PERSISTENT								
t.	Dwarf Salix-Sedge-Rush d.t.	SEDGE-RUSH-GRASS d.t.					SEDGE-GRASS d.t.			
Saca Cami Phase		Cars Juba Phase	Cami Juba Phase	Cars Judr Phase	Cami Jual Phase	Cavs Cars Judr Phase	Cavs Cars Cala Phase	Cars Phase	Cars Cala Phase	Cave Phase
2	2	1	1	1	4	1	1	1	1	2
								3.3		
			6.7		1.8			3.3		
1.6					0.8			6.7		
15.0					0.8		3.3			
	1.5	6.7								
5.0										
45.0	33.3				4.0					
23.4	100.0				14.2	16.7				1.5
			26.7		10.0		3.3			10.0
25.0					4.1		56.7		90.0	3.3
65.0		20.0	86.7	43.3	46.7	6.7	13.3		33.3	15.0
26.7	5.0	93.3		86.7		50.0	63.3	66.7	10.0	
1.6	3.3				22.5	73.3	3.3		3.3	83.3
10.0					5.6		70.0			
55.0	5.0	70.0	20.0	20.0	45.0	23.3	23.3	36.7	73.3	83.4
3.3	75.0				8.0	3.3				
		30.0								
3.0	3.3			36.7	0.8	6.7				
			33.3							
24.3	8.3	63.3	63.3	20.0	27.5	20.0		20.0	53.3	36.7
1.5		3.3	36.7						23.3	6.7
16.7			26.7		18.3	33.3	6.7			
26.7					30.0	10.0				31.3
6.7		60.0	43.3		54.2	16.7		46.7	6.7	78.9
43.3	6.7	3.3			52.5	20.0		13.3	16.7	49.3
1.5					24.2	33.3				61.8
38.3	3.3	6.7			45.8	3.3		36.7		26.2
10.0	3.3				15.8	26.7				10.0
5.0	1.7	33.3	63.3		14.2	10.0	3.3	63.3	3.3	38.1
		40.0	46.7		13.3	6.7		36.7	36.7	28.3
10.0		70.0	83.3		20.0	10.0		70.0	20.0	25.0
					5.0					5.0

Appendix F

Mammal Species Observed in Riparian Habitats of East Fork Smiths Fork River

Species
Shrew (*Sorex* sp.)
Snowshoe Hare (*Lepus americanus*)
Yellow-bellied Marmot (*Marmota flaviventris*)
Golden-mantled Ground Squirrel (*Spermophilus lateralis*)
Least Chipmunk (*Eutamius minimus*)
Red Squirrel (*Tamiasciurus hudsonicus*)
Northern Pocket Gopher (*Thomomys talpoides*)
Beaver (*Castor canadensis*)
Deer Mouse (*Peromyscus maniculatus*)
Montane Vole (*Microtus montanus*)
Long-tailed Vole (*Microtus longicaudus*)
Richardson's Vole (*Microtus richardsoni*)
Muskrat (*Ondatra zibethicus*)
Western Jumping Mouse (*Zapus princeps*)
Porcupine (*Erethizion dorsatum*)
Black Bear (*Ursus americanus*) tracks only
Marten (*Martes americana*)
Short-tailed Weasel (*Mustela erminea*)
Long-tailed Weasel (*Mustela frenata*)
Striped Skunk (*Mephitis mephitis*)
Elk (*Cervus canadensis*)
Mule Deer (*Odocoileus hemionus*)
Moose (*Alces alces*)

Appendix G

Bird Species Observed in Riparian Habitats of the East Fork Smiths Fork River

Species
Eared Grebe (*Podiceps nigricollis*)
Great Blue Heron (*Ardea herodias*)
Mallard (*Anas platyrhynchos*)
Green-winged Teal (*Anas crecca*)
American Widgeon (*Anas americana*)
Ring-necked Duck (*Aythya collaris*)
Goshawk (*Accipiter gentilis*)
Sharp-shinned Hawk (*Accipiter striatus*)
Cooper's Hawk (*Accipiter cooperii*)
Marsh Hawk (*Circus cyaneus*)
Red-tailed Hawk (*Buteo jamaicensis*)
Swainson's Hawk (*Buteo swainsoni*)
Golden Eagle (*Aquila chrysaetos*)
Osprey (*Pandion haliaetus*)
Prairie Falcon (*Falco mexicanus*)
Peregrine Falcon (*Falco peregrinus*)
American Kestrel (*Falco sparverius*)
White-tailed Ptarmigan (*Lagopus leucurus*)
Sage Grouse (*Centrocercus urophasianus*)
Sora (*Porzana carolina*)
American Coot (*Fulica americana*)
Killdeer (*Charadrius vociferus*)
Common Snipe (*Capella gallinago*)

Spotted Sandpiper (Actitus macularia)

California Gull (Larus californicus)

Mourning Dove (Zenaida macroura)

Great Horned Owl (Bubo virginianus)

Long-eared Owl (Asio otus)

Saw-whet Owl (Aegolius acadicus)

Common Nighthawk (Chordeiles minor)

Broad-tailed Hummingbird (Selasphorus platycercus)

Rufous Hummingbird (Selasphorus rufus)

Belted Kingfisher (Megaceryle alcyon)

Common Flicker (Colaptes auratus)

Yellow-bellied Sapsucker (Sphyrapicus varius)

Williamson's Sapsucker (Sphyrapicus thyroideus)

Hairy Woodpecker (Dendrocopos villosus)

Downy Woodpecker (Dendrocopos pubescens)

Northern Three-toed Woodpecker (Picoides tridactylus)

Hammond's Flycatcher (Empidonax hammondii)

Dusky Flycatcher (Empidonax oberholseri)

Western Flycatcher (Empidonax difficilis)

Western Wood Pewee (Contopus sordidulus)

Olive-sided Flycatcher (Nuttallornis borealis)

Horned Lark (Eremophilus alpestris)

Violet-green Swallow (Tachycineta thalassina)

Tree Swallow (Iridoprocne bicolor)

Barn Swallow (Hirundo rustica)

Gray Jay (Perisorius canadensis)

Steller's Jay (Cyanocitta stelleri)

Mountain Chickadee (Parus gambeli)

Red-breasted Nuthatch (Sitta canadensis)

Brown Creeper (Certhia familiaris)

Dipper (Cinclus mexicanus)

Sage Thrasher (Oreoscoptes montanus)

American Robin (Turdus migratorius)

Hermit Thrush (Catharus guttatus)

Swainson's Thrush (Catharus swainsoni)

Mountain Bluebird (Sialia currucoides)

Townsend's Solitaire (Myadestes townsendi)

Ruby-crowned Kinglet (Regulus calendula)

Water Pipit (Anthus spinoletta)

Warbling Vireo (Vireo gilvus)

Orange-crowned Warbler (Vermivora celata)

Yellow-rumped Warbler (Dendroica coronata)

Mac Gillivray's Warbler (Oporornis tolmiei)

Wilson's Warbler (Wilsonia pusilla)

Western Meadowlark (Sturnella neglecta)

Red-winged Blackbird (Agelaius phoeniceus)

Brewer's Blackbird (Euphagus cyanocephalus)

Brown-headed cowbird. (Molothrus ater)

Cassin's Finch (Carpodacus cassinii)

Pine Grosbeak (Pinicola enucleator)

Black Rosy Finch (Leucosticte atrata)

Pine Siskin (Spinus pinus)

American Goldfinch (Spinus tristis)

Red Crossbill (Loxia curvirosta)

Savannah Sparrow (Passerculus sandwichensis)

Vesper Sparrow (Pooecetes gramineus)

Dark-eyed Junco (Junco hyemalis)

Chipping Sparrow (Spizella passerina)

Brewer's Sparrow (Spizella breweri)

White-crowned Sparrow (Zonotrichia leucophrys)

Lincoln's Sparrow (Melospiza lincolnii)